

REPORT  
OF THE  
DEPARTMENT OF MINES  
FOR THE  
FISCAL YEAR ENDING MARCH 31, 1921

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OTTAWA

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1921

REPORT

DEPARTMENT OF MINES

FOR THE

FISCAL YEAR ENDING MARCH 31, 1921



*To His Excellency Baron Byng of Vimy, G.C.B., G.C.M.G., M.V.O., Governor  
General and Commander in Chief of the Dominion of Canada.*

MAY IT PLEASE YOUR EXCELLENCY:

The undersigned has the honour to lay before Your Excellency, in compliance with 6-7 Edward VII, chapter 29, section 18, the report of the work of the Department of Mines, for the fiscal year ending March 31, 1921.

JAMES LOUGHEED,  
*Minister of Mines.*

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# REPORT

## OF THE

### DEPARTMENT OF MINES

FOR THE FISCAL YEAR ENDING MARCH 31, 1921

HON. SIR JAMES LOUGHEED, K.C.M.G., P.C., K.C.,  
Minister of Mines,  
Ottawa.

Sir,—I have the honour to submit the Annual Report of the Department of Mines for the year ending March 31, 1921.

#### GENERAL REMARKS

The Department of Mines as originally created in 1907 consisted of two branches, namely, the Geological Survey and the Mines Branch. Several changes have since been made so that the organization now consists of seven distinct units, namely, the Geological Survey, Victoria Memorial Museum, Mines Branch, Explosives Division, Editorial Division, Accounting Division, and the Administrative Division.

The year covered by this report has been marked by a number of important changes in the department which have been due partly to conditions affecting the mining industry throughout the world, and partly to other causes incidental to the passage of time. The resignation and superannuation of R. G. McConnell took effect on March 7 after nearly forty years of faithful and efficient service, first, as geologist in the Geological Survey, and later as Deputy Minister of the Department.

The museum activities of the department were separated from the Geological Survey and William McInnes placed in charge as Director of the Victoria Memorial Museum. He was succeeded as Director of the Geological Survey by W. H. Collins.

On December 15, 1920, Eugene Haanel retired as Director of the Mines Branch and up to the end of the year his position had not been filled. Other changes in personnel are noted in the reports submitted by the directors of branches.

The losses sustained by the department in technical officers were exceptionally heavy in the early part of this year and the year immediately preceding, amounting in all to twenty, of whom eleven were geologists. These losses were due to the heavy demands during that period made by mining and allied industries for the services of technically trained men. The extraordinary interest in mineral oil resources throughout the world and the urgent desire of certain countries to obtain control of and exploit these oil resources, caused a strong demand for geologists which resulted in the department losing the services of a large proportion of its geological staff, and the high qualifications demanded of our geologists and the long training to which they had been subjected made these men very desirable acquisitions to the staffs of oil mining companies. The universities have also recruited from the technical staff of the Geological Survey to a considerable extent.

The activity in mining generally throughout the greater part of the year 1920 was responsible also for the resignations of a number of engineers and chemists who were

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able to find more lucrative positions in commercial work than in government service. This condition, however, has now changed, and for several months past the mining industry has been in a worse state of depression than at any previous period, and virtually the only phases of the industry that are in at all healthy condition are the gold and oil mining industries. The result is that for the time being it is possible to retain the services of technical officers, though as soon as the mining industry recovers from its present state of depression the same difficulties will again arise. If, therefore, the department is going to be able to attract and retain the type of man that is needed, an improvement must be made in the salaries paid. The difference between government salaries and those obtaining in commercial work and even in the universities is at present too great, and unless this is rectified there are bound to be frequent and recurrent changes of personnel resulting in a general lowering of standard both in the class of men employed and in the character of work done. This state of affairs is one that should be avoided if at all possible, since the work of the department is such that only the most highly trained men should be employed, for anything short of the best is worse than none at all.

#### TRANSFER OF STATISTICS

Statistics of production, consumption, prices, etc., of mineral resources have been kept by the Department since 1907, and previously by the Geological Survey since 1886, and the annual reports have formed a continuous series for thirty-five years. In accordance with the policy of the Government, however, for the centralization of the collection of statistics, an Order in Council was passed on May 22, 1920, transferring to the Dominion Bureau of Statistics all the purely statistical work of this Department. This has been done without any break in the continuity of the work, and in future the Dominion Bureau of Statistics will collect and compile all mining statistics while this Department will concern itself with detailed analyses of the figures for inclusion in annual reports on the mineral industry.

#### IMPERIAL MINERAL RESOURCES BUREAU

The Imperial Mineral Resources Bureau was organized in London in 1918 and all parts of the British Empire were invited to co-operate in its work. The objects of the Bureau are to collect and disseminate information as to mineral resources throughout the Empire, and to endeavour to make the Empire independent of foreign countries in respect to mineral supplies. Canada is represented on the Board of Governors by Dr. W. G. Miller of Toronto, and the publicity given Canadian mineral resources in London and elsewhere has already resulted to our benefit and will, probably, serve to attract more capital to this country as the work of the Bureau expands and becomes better known.

#### CHANGE OF QUARTERS

After the main Parliament buildings were burned on February 3, 1916, the members of the Senate and House of Commons occupied the Victoria Memorial Museum, and the Geological Survey staff was forced into temporary quarters in various buildings throughout the city. Parliament returned to the new building early in 1920 and the Museum was then refitted and was ready for reoccupation by the Geological Survey and Museum staff in August of that year. Part of the building formerly occupied by this department was, however, allotted to the National Art Gallery, with the result that the space available for exhibits is now still more inadequate for our requirements.

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## PEAT INVESTIGATIONS

The Peat Committee, consisting of representatives from both the Dominion Government and the Ontario Government, continued its work in the manufacture of air-dried peat fuel at the bog at Alfred, Ontario.

Two machines were in operation, though not continuously, throughout the season, and nearly 6,000 tons of peat fuel were produced. This was sold for household purposes in Ottawa, Peterborough, and other neighbouring points. The plans of the Peat Committee provide for the combining of the best features of the two machines into a third, which would be built and ready for a try out before the end of the season of 1921. Considerable success has attended these investigations and far greater progress has been made in Canada towards the manufacture of a cheap fuel than in any other country in the world.

## THE MINING INDUSTRY

The total value of the mineral production of Canada for 1920 was \$227,859,665, which is greater than the total value reached in any preceding year. This was an increase of about 24 per cent over 1919 and more than 3 per cent over 1918, which was up to 1920 the banner year. Towards the close of the year, however, a depression set in and one after the other mines were closed down until a stage has been reached in the mining industry worse than at any previous time during this century. This condition is, however, only a temporary one, and the mining industry is bound to react with a revival of business conditions in other industries.

An event of far reaching importance in mineral development was the discovery during the year of oil near Fort Norman in the Mackenzie River country, by the Imperial Oil Company. The well at which oil was struck is situated over 1,000 miles from the nearest railway, in country almost uninhabited, but the significance of the discovery can be better appreciated when it is realized that it proves the presence of oil in a formation which covers some thousands of square miles of that northern territory. Its importance is increased by the fact that Canada's total production of oil today is sufficient to meet less than 2 per cent of our requirements; and that we are dependent on imports from foreign countries of over 98 per cent of our consumption of oil. It will, however, be some years yet before the field is proved, transportation difficulties overcome, and oil from the Mackenzie country marketed in our western cities. The department has advised oil-prospecting companies to test the rock formation in the country adjacent to the western end of Great Slave lake, because this appears to be the southern border of the possible oil-bearing Devonian rocks and if oil were found in this part of the field it would be much more available to the markets of this country.

Appropriations for the work of the Department of Mines have not been increased in proportion to the growth of the industry which it is designed to assist, but in view of the heavy burden of debt that the country has to carry it has been the constant endeavour of the heads of branches to avoid increased expenditures and to so organize the work that a larger return is made to the country for the amounts expended. It is satisfactory to record that this endeavour has met with a larger measure of success than might have been expected in view of the increased cost of carrying on field and laboratory investigation.

In all respects the work of the various branches of the department has been carried on in a most efficient and satisfactory manner by the officers in charge.

The reports of the chief officers of the department follow.

I have the honour to be, sir,

Your obedient servant,

CHARLES CAMSELL,

*Deputy Minister.*



## GEOLOGICAL SURVEY

*W. H. Collins, Director*

### ORGANIZATION

During November, 1920, the Museum-building activities of the Geological Survey were in large part transferred to a new branch of the Department of Mines, the Victoria Memorial Museum. The Geological Survey now comprises the following units:

Director, W. H. Collins.  
Geological Division, under the Director.  
Topographical Division, W. H. Boyd, in charge.  
Mineralogical Division, R. A. A. Johnston, in charge.  
Palæontological Division, E. M. Kindle, in charge.  
Borings Division, E. D. Ingall, in charge.  
Draughting Division, C.-O. Senécal, in charge.  
Photographic Division, G. G. Clarke, in charge.  
Distribution Division, Wyatt Malcolm, in charge.  
Library, Mrs. F. E. Forsey, in charge.

The main part of the institution is located at Ottawa; but for economy and convenience in dealing with the requirements of the western part of Canada a British Columbia branch, under the present direction of J. D. MacKenzie, is maintained at rooms 509-512 Pacific Building, Vancouver.

### CHANGE IN PERMANENT STAFF

By the death of W. J. Wilson, palæobotanist, on August 21, 1920, the Survey suffered the loss of one of its oldest and most respected members.

#### *Resignations*

L. D. Burling, associate palæontologist.  
Leopold Reinecke, associate geologist.  
J. J. O'Neill, associate geologist.  
Bruce Rose, associate geologist.  
A. O. Hayes, associate geologist.  
E. L. Bruce, associate geologist.  
B. R. MacKay, associate geologist.  
S. J. Schofield, geologist.  
M. Y. Williams, geologist.  
J. R. Cox, topographer.  
F. S. Falconer, topographer.

Drs. Schofield and Williams accepted positions in the University of British Columbia, and Dr. Bruce a position in Queen's University. The other gentlemen accepted employment with various companies engaged in exploration for petroleum and other minerals.

#### *Transfers*

Charles Camsell, geologist, was made Deputy Minister of Mines on the resignation of R. G. McConnell.

William McInnes, Director of the Geological Survey, was made Director of the Victoria Memorial Museum.

W. H. Collins, geologist, was made Director of the Geological Survey.

### CHANGES IN QUARTERS

Following the burning of the Parliament buildings on February 3, 1916, the Victoria Memorial Museum building was occupied by Parliament, and the Geological

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Survey took up temporary quarters in various smaller buildings throughout the city. Parliament removed to its new buildings in the early part of 1920. The Museum building was then refitted and by the latter part of August was reoccupied by the Survey and Museum staffs. The building now houses all the Geological Survey and Victoria Memorial Museum staffs except the Division of Mineralogy and part of the Distribution Division, for which room cannot be made. The Division of Mineralogy has its offices, laboratories, and mineral exhibits at 227 Sparks street. The stock of printed publications and part of the staff of the Distribution Division are housed at 347 Wellington street.

## WORK OF THE GEOLOGICAL DIVISION

In conformity with the policy of previous years geological work was carried on throughout Canada. A large share of this work was directed towards the investigation of mineral deposits or of areas of prospective economic interest.

W. E. Cockfield made a detailed investigation of the Keno Hill silver-lead ore deposits near Mayo, Yukon. High-grade ore is being taken from a number of these deposits and much attention is, in consequence, being given the district by prospectors. A detailed geological map of the Keno Hill area and a report dealing with the nature, distribution, and theory of origin of the ore deposits appear in the Summary Report of the Geological Survey, Part A.

S. J. Schofield and George Hanson completed the mapping and study of the ore deposits in the Salmon River district, British Columbia, this work having been commenced in 1919 by J. J. O'Neill. A description of the Premier mine and other ore deposits which are chiefly valuable for their contents of gold and silver is given in the Summary Report, Part A.

Victor Dolmage continued the geological exploration of the coast of British Columbia, upon which he has been engaged since 1918. The season of 1920 was spent on the west coast of Vancouver island between Barkley and Quatsino sounds. Occurrences of gold, copper, iron, manganese, marble, and natro-alunite are reported from this section of the coast in the Summary Report, Part A.

R. W. Brock made a reconnaissance of the country surrounding Eutsuk, Whitesail, and Ootsa lakes, south of the Grand Trunk Pacific railway. Occurrences of zinc blende, galena, and other sulphides carrying low values in gold and silver were noted. An extensive report upon this district appears in the Summary Report, Part A.

W. A. Johnston continued his investigation of the lower part of Fraser river and its delta and of the adjacent country. This work was undertaken in 1919 for the purpose of providing information which would assist the Department of Public Works in improving and fixing the navigable channels of the river. A full report upon Fraser river and its delta is given in Memoir 125, "Sedimentation of the Fraser River delta," recently published.

C. E. Cairnes commenced the geological mapping of the Coquihalla map-area, near Hope, about 90 miles east of Vancouver. A topographic map of the area has already been made by F. S. Falconer, of the Topographical Division of the Survey. A preliminary report upon the district and its gold, silver, and molybdenum and manganese deposits appears in the Summary Report, Part A.

J. D. MacKenzie made a careful examination of the extent and origin of certain deposits of brown iron ore near the headwaters of Taseko (Whitewater) river, Lillooet district, B.C. A topographic base map was prepared at the same time by C. H. Freeman of the Topographical Division of the Survey. Much interest had been aroused by reports of the size of these deposits and the excellence of the ore. A full report upon these deposits is given by Mr. MacKenzie in the Summary Report, Part A, in which he estimates the tonnage of ore at 669,350 tons.

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A further report of much scientific interest is made upon the geology of the district traversed between the ore deposits and Fraser river.

W. S. McCann completed the geological mapping of the Bridge River map-area. A complete report, accompanied by maps, has been written and is now awaiting publication.

M. F. Bancroft continued his investigation and systematic mapping of the Lardeau district, B.C. A preliminary report upon the work done in 1920 is given in the Summary Report, Part A.

J. R. Marshall completed the geological mapping of the Upper Elk and Upper Highwood Rivers (Pekisko) map-sheets. The area in question lies along the Alberta-British Columbia boundary, about 60 miles south of the main line of the Canadian Pacific railway. It is part of the great coal-bearing area of this region, and the work was done to ascertain the extent and conformation of the coal seams. A short preliminary report appears in the Summary Report, Part B.

D. B. Dowling reviewed the deep drilling and other prospecting work for petroleum and natural gas in Alberta and Saskatchewan. A report upon the present condition of development of these resources appears in the Summary Report, Part B. A second report upon the deep-lying coal seams of the Souris coal-field, Saskatchewan, appears in the same publication.

G. S. Hume surveyed and mapped the geological formations along the northwest coast of Great Slave lake in continuation of the work of A. E. Cameron, 1916 and 1917. This lies on the eastern margin of the great Mackenzie River basin of Devonian rocks, in which oil is believed to occur in commercially important quantities. Mr. Hume's report in the Summary Report of the Geological Survey, Part B, discusses the possibilities of finding oil at Great Slave lake.

F. J. Alcock continued the exploration of the Precambrian region of northern Manitoba to delimit the areas therein which will be of greatest interest to prospectors. Three short reports upon the work accomplished appear in the Summary Report, Part C.

W. S. McCann spent the first half of the season mapping and investigating the extent, origin, and commercial possibilities of recent discoveries of nickel-bearing sulphides east of lake Winnipeg. These deposits are similar in mineralogical character to the great Sudbury nickel-copper deposits and like them are closely associated with an intrusive body of norite. Consequently, exceptional interest has been taken in them by prospectors. A complete report of Mr. McCann's work, accompanied by maps, appears in the Summary Report, Part C.

T. L. Tanton continued the geological mapping and investigation of the mineral resources of an area lying north and east of Port Arthur, Ontario. Special attention was given to a study of Sibley peninsula close to which lies Silver islet, from which in the seventies \$3,125,000 worth of silver was extracted. An effort is being made by Mr. Tanton to ascertain whether mineralization was not localized along a system of faults which traverse Sibley peninsula. This investigation will be continued in 1921, but a short preliminary statement of results appears in the Summary Report, Part D.

W. H. Collins completed the geological mapping of an area near Michipicoten harbour, Ontario, in which are important deposits of iron ore and pyrite, and some occurrences of gold.

Ellis Thomson began the geological mapping of an area contiguous to that mapped by Mr. Collins, and also containing deposits of pyrite, iron ore, and gold. In both these areas the intelligent prospecting for iron ore and pyrite depends in a large degree upon a knowledge of the folding and faulting of the region.

T. T. Quirke mapped the townships of Hess and Moncrieff, Ontario. A full report upon this work, which is an important contribution to the Precambrian geology of northeastern Ontario, appears in the Summary Report, Part D. The report is accompanied by a geological map.

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M. Y. Williams continued his investigation of the oil-bearing possibilities of the James Bay basin. He also completed a more detailed investigation of the oil resources of Manitoulin island. Reports upon both investigations appear in the Summary Report, Part D.

M. E. Wilson commenced the geological mapping and a restudy of the mineral resources of an area near Madoc, Ontario. This district contains an unusual variety of economic mineral deposits, including talc, fluorite, and pyrite. It is also one of the most interesting in Canada from the standpoint of the specialist in Precambrian geology. A full, illustrated account of the fluorite deposits of the district appears in the Summary Report, Part D.

J. F. Wright geologically mapped a Precambrian area near Mallorytown, Ontario, and also made a detailed study of the iron-ore deposit at Delta, Ontario. A preliminary report upon this work appears in the Summary Report, Part D.

Aleph Anrep continued his systematic survey of the peat bogs of eastern Canada. A brief résumé of the work accomplished during 1920 is given in the Summary Report, Part D.

Robert Harvie continued his geological study of the asbestos deposits near Black Lake and Thetford, Quebec. He also examined an occurrence of asbestos in Bonaventure county, Quebec, a short report upon which is given in the Summary Report, Part D.

G. A. Young made an examination of a number of coal seams in Gloucester county, N.B., in which renewed interest has been taken recently. A full report upon these outcrops is given by Mr. Young in the Summary Report, Part E.

E. R. Faribault continued the systematic geological mapping of Nova Scotia, devoting his attention in 1920 to the Berwick and Lakeview map-areas, in Kings and Annapolis counties. A preliminary report upon the geology and the occurrences of gold, manganese, iron ore, antimony, and other minerals appears in the Summary Report, Part E.

## TOPOGRAPHICAL DIVISION

W. H. Boyd, Chief Topographer, reports as follows on the work of the year 1920:

### FIELD WORK

*Upper Kitzault River.* W. H. Miller mapped an area of 35 square miles embracing the mining activities in the Upper Kitzault valley. The map will be published on the scale of 1 mile to 1 inch with a 100-foot contour interval.

*Fraser River Delta and Vancouver, B.C.* A. C. T. Sheppard and A. G. Haultain completed the mapping in connexion with the Fraser River investigation. The result will be a general map of the whole Fraser River delta from the International Boundary line to the north shore of Burrard inlet and from a north and south line through Fort Langley to the strait of Georgia. Pitt river up to Pitt lake was also included. The total area of the map is about 580 square miles. This map will be published on the scale of 1 mile to 1 inch with a contour interval of 40 feet.

A map of the city of Vancouver, scale 1,000 feet to 1 inch with a contour interval of 25 feet, shows all the railways, electric tram lines, streets, roads, and buildings, as well as a great mass of other information, in the area generally spoken of as "Greater Vancouver." This area lies between Burrard inlet and the north arm of Fraser river on the north and south, and between point Grey and Boundary road on the west and east.

*Eutsuk Lake, B.C.* S. C. McLean completed a survey of Eutsuk lake, Whitesail river, and the western half of Ootsa lake.

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Eutsuk lake is 47 miles long with an average width of 1½ miles and has about 150 miles of shore-line. Whitesail river—including its expansion into Sinclair, or Long lake—is 15 miles long; the western half of Ootsa lake from Ootsa Lake post office to its head is about 22 miles long. In all about 195 miles of shore line traverse was completed.

The work was done in conjunction with the British Columbia Department of Lands, Mr. Swannell, their surveyor in the field, and Mr. McLean collaborating in the work. In this way much time was saved and unnecessary duplication avoided.

*Taseko River, B.C.* C. H. Freeman completed a map of an area in the valley of Taseko river, B.C. The map comprises an area of 35 square miles and was made for a publication scale of 1 mile to 1 inch with a contour interval of 100 feet.

Mr. Freeman also made a traverse of the trail from Bridge river at Gun creek into the area for the purpose of carrying elevations into the district.

*Barkerville, Cariboo.* D. A. Nichols mapped an area of 210 square miles around Barkerville, Cariboo, B.C. This map, which embraces the more important creeks where hydraulic and placer operations for gold are being carried out, will be published on the scale of 1 mile to 1 inch with a contour interval of 100 feet.

*Thunder Cape, Ont.* R. Bartlett mapped about 30 square miles of Thunder Cape peninsula, lake Superior, Ontario. This area includes Thunder cape itself and shows the location of Silver islet. The work was carried out for a publishing scale of 1 mile to 1 inch with a 50-foot contour interval.

*Marmora, Ont.* E. E. Freeland carried on the work in connexion with the mapping of the area of 250 square miles in the vicinity of Marmora, Ontario. Although the map does not show any relief it shows all railways, roads, towns, dwelling houses, etc., as well as the drainage system. The scale of publication is 1 mile to 1 inch.

*Madoc, Ont.* R. C. McDonald mapped a similar area adjoining the Marmora area, in the vicinity of Madoc, Ontario. The type of map in these two areas is the same.

Mr. McDonald also completed the triangulation control for the two maps.

*Joggins, N.S.* K. G. Chipman made a detail map of a strip of country 2 miles wide and 14 miles long extending from Joggins, N.S., in a northeasterly direction. The map includes Maccan and Chignecto. This map has been compiled on a scale of 1,000 feet to 1 inch with 10-foot contours.

## OFFICE WORK

Briefly, the regular office work of the division consists in assembling and compiling the information obtained in the field into complete manuscript maps of the areas surveyed. After the compilation is completed the maps are "inked-in," generally using three colours to distinguish between the works of man, drainage, and relief. Name sheets are then prepared showing all the names that are to appear on each map and the features to which the names apply. The manuscript map is then ready to pass on for reproduction.

In addition to the regular work, the division completed the preparation of the special maps and diagrams to illustrate the report on the Fraser River investigation.

## MINERALOGICAL DIVISION

R. A. A. Johnston, Chief of the Division, reports that office, research, and field work was continued as usual.

## EXHIBITION WORK

In regard to the Exhibition of Chemical Industries to be held in New York in September 1921, he writes:

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In July, 1920, instructions were received to prepare for a display of Canadian economic minerals at the Seventh National Exposition of Chemical Industries, which is to be held in Eighth Coast Artillery Armory, New York, September 12-17, 1921. Mr. McKinnon was detailed to make collections from a number of localities in Ontario, Quebec, and the Maritime Provinces, and the department was able to secure the services of Mr. W. Thomlinson from August to December for making a collection from important mining centres in the Southern Interior and Boundary districts of British Columbia. Large and representative collections have been brought together by both these gentlemen from the districts under their charge. Some very interesting material has been secured from Yukon owing to the interest taken by Mr. G. P. MacKenzie, Commissioner of the territory; and through the kindly assistance of Professors R. C. Wallace and A. T. Delury, a fine series of specimens has been obtained from some of the latest discoveries in northern Manitoba. A number of private individuals and firms have generally assisted by means of donations or loans.

An advantageously situated block having a frontage of 60 feet and a depth of 14 feet has been engaged and the outlook for a full and representative display of the principal economic minerals of this country is very promising.

### PALÆONTOLOGICAL DIVISION

E. M. Kindle, Chief of the Division, reports that he made a trip to southern Florida and the Bahamas early in the winter for the purpose of collecting a series of the calcareous deposits, corals, and recent limestones to be used in Museum exhibits illustrating the formation of limestones.

F. H. McLearn was engaged during the summer in studying the Mesozoic stratigraphy and faunas of the Upper Peace River section of western Alberta.

Miss A. E. Wilson studied the Ordovician sections along the southwest shores of lake Winnipeg.

E. J. Whittaker spent a part of the field season in the upper part of the St. Lawrence valley locating and collecting from the most westerly deposits of the fossils representing the post-glacial marine submergence of parts of eastern Canada.

W. A. Bell resumed in the Nova Scotia coal field a study of the Carboniferous floras and faunas, which had been interrupted by four years of war service.

E. M. Kindle with the co-operation of engineers of the dredging branch of the Department of Public Works made a traverse across lake Ontario from Toronto to Niagara river taking bottom samples at frequent intervals.

The division has been fortunate in securing the co-operation of Dr. C. D. Walcott of the Smithsonian Institution in studying the Cambrian collections made by L. D. Burling while a member of this division.

The memoir on the Arisaig Silurian fauna of Nova Scotia by F. H. McLearn is nearly completed.

W. A. Bell has been engaged on a monograph on the Windsor fauna of Nova Scotia.

The results of research work during the year by Miss A. E. Wilson on Ordovician faunas, and by E. J. Whittaker on Pleistocene faunas are embodied in papers published in Bulletin 33, Geological Survey.

A joint report by E. M. Kindle and T. O. Bosworth on the oil-bearing rocks of the Mackenzie valley appears in the Summary Report, Part B.

Preparatory work has continued throughout the year on several specimens of large vertebrate fossils representing the Red Deer River Cretaceous fauna. The

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largest of these, *Gorgosaurus libratus*, a carnivorous dinosaur about 20 feet in length, has been mounted in the exhibition hall of parliament bay, which is being made ready to reopen to the public. A number of smaller specimens have also been prepared and mounted for exhibition by C. M. Sternberg and his assistants.

*Donations*

The collections of the division have been enriched by the presentation to the Survey of the large and valuable private collection of Ordovician crinoids and other fossils made by the late Walter Billings. The collection was presented by Miss Myra Billings in accordance with the wishes of her brother.

Another notable donation received during the year is the lower jaw of a young mammoth from the Klondike district, Yukon. The thanks of the department are due to the following for donations: Acheson, L., Andrews, W. W., Beede, J. W., Foerste, A. F., Gunter, H., Imperial Oil Co. (per T. O. Bosworth and T. A. Link), Johnston, Miss M. S., Kerschner, H. M., LaFerrier, Father, Martin, Bro., Middlebrook, J., Nylander, Olaf O., United States National Museum.

## BORINGS DIVISION

E. D. Ingall, Chief of the Borings Division, reports as follows:

The staff of the division consists now of the geologist in charge; one assistant geologist; one museum assistant; one museum helper; and a stenographer.

Removal from the offices on Wellington street to the Victoria Memorial Museum was accomplished without delay and loss, and the work of the division is proceeding as usual.

## FIELD WORK

During August and September, J. A. Robert helped with the field work being prosecuted by the Mines Branch along St. Lawrence river.

## OFFICE WORK

The work of collecting logs of borings in various parts of Canada was continued during the year, the particulars regarding this work being given in the tabulation below.

	No. of sample bags sent out	No. of samples received	No. of wells from which samples were received	No. of records received	No. of circulars sent out
Maritime Provinces	2,850	2,617	19	41	
Quebec	200	53	1	15	
Ontario	2,300	2,070	16	544	
Northwest Provinces	4,300	599	7	635	
British Columbia	550	43	1	15	
	10,200	5,382	44	1,250	750

Interpretation of the sets of samples sent in by drill operators for their guidance during the progress of their operations occupied a considerable part of the time.

With the increased staff of the Borings Division now available this co-operation between the division and the public can be extended considerably.

Thanks are due especially to those whose names follow: W. B. H. Co., Drilling Co., Montreal; Mr. F. Beauchamp, driller, Montreal; H. Friend, drilling contractor, Aylmer Road, Que.; R. I. Henderson, oil and gas operator, Toronto; H. Cable, drilling contractor, Waterford, Ont.; Blue Mountain Oil and Gas Co., Collingwood, Ont.; Boston Alberta Oil Co., Boston, U.S.A.; Rev. Father Laniel, Vankleek Hill, Ont.; New Brunswick Oil and Gas Co., Moncton, N.B.; D'Arcy Exploration Co., Moncton, N.B.; H. F. Ratheram, drilling inspector, Winnipeg, Man.; Nova Scotia Chemical Co., A. DeBruyne, Aylmer, Que.; Kyto Oil and Gas Co., Sheguindah, Ont.; West Williams Oil and Gas Co., Parkhill, Ont.; Peace River Petroleum, Ltd., A. M. Slack, Peace River, Alberta; Crow's Nest Oil Co., Spokane, Wash., U.S.A.; W. E. McMullen, Dept. Lands and Mines, Fredericton, N.B.; Mr. Kelly, drilling contractor, Ottawa, Ont.; Casper Braun, oil and gas operator, Kitchener, Ont.; Imperial Oil and Gas Co., Toronto, Ont.; Rockwood Oil and Gas Co., Toronto, Ont.; J. H. Macleod, oil and gas operator, Glencoe, Ont.; F. W. James, oil and gas operator, Chatham, Ont.; Geo. Jamieson, Haileybury, Ont.; Brunner Mond Co., Amherstburg, Ont.; E. P. Rowe, manager, Valley Gas and Oil Co., Toronto, Ont.; Dominion tire factory, Kitchener, Ont.; F. J. Carman, oil and gas operator, Glencoe, Ont.; Wm. Welsh, Kincardine, Ont.; T. Papps, driller, Ottawa, Ont.

GEOGRAPHICAL AND DRAUGHTING DIVISION

C.-Omer Sénécal, Geographer and Chief Draughtsman, reports as follows:  
Forty-six new maps were published; seventeen maps are, at present, in the hands of the King's Printer for engraving, lithographing, and printing; and forty-four other maps are in progress in the office, including several sheets of the Nova Scotia series, the compilation of which was completed. About one hundred drawings of sketch maps, diagrams, text figures, and miscellanies were also executed for the illustration of geological memoirs, reports, etc.  
The chief of this division also performed the duties of a member of the Geographic Board of Canada.

Maps in Hands of the King's Printer, March 31, 1921

Publication number	Title	Date of requisition
155A, 1553	Algoma, Sudbury, and Timiskaming districts, Ontario; scale, 8 miles to 1 inch.....	Dec. 15, 1919
1771	Winnipegosis, Manitoba, soil map; scale, 3 miles to 1 inch....	Aug. 20, 1920
1802	Upper Whitemouth river, Manitoba, soil map; scale, 3 miles to 1 inch .....	Aug. 20, 1920
1830	Vermilion, Alberta, topographical map; scale, 3 miles to 1 inch..	Nov. 24, 1920
1831	Vegreville, Alberta, topographical map; scale, 3 miles to 1 inch..	Nov. 24, 1920
1838	Rat River route, from Threepoint lake to Southern Indian lake, Manitoba; scale, 8 miles to 1 inch.....	Jan. 11, 1921
1839	The Seal-Churchill divide, Manitoba; scale, 6 miles to 1 inch....	Jan. 11, 1921
1841	Maskwa River nickel-copper deposits, Manitoba; scale, ¼ mile to 1 inch.....	Jan. 11, 1921
1842-1848	Seven detail geological diagrams, showing limonite deposits in Taseko valley, Lillooet district, British Columbia; scale, 400 feet to 1 inch.....	March 5, 1921
1849	Taseko River area, Lillooet district, British Columbia, geological and topographical map; scale, 3,000 feet to 1 inch.....	March 5, 1921
1859	Route map of country between French Bar creek (Fraser river) and Taseko lake, Lillooet district, British Columbia; scale, 6 miles to 1 inch.....	March 5, 1921

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## Maps Published January 1, 1920, to March 31, 1921

Publication number	Title	Remarks
YUKON		
1812	Sixtymile and Ladue rivers; scale, 4 miles to 1 inch. ....	Geology
MACKENZIE		
1585	Mackenzie River basin; scale, 50 miles to 1 inch. ....	Geology, 2nd edition
BRITISH COLUMBIA		
185A, 1641	Sandon (Slocan and Ainsworth mining divisions), Kootenay district; scale, 4,000 feet to 1 inch. ....	Topography
1784	Diagram showing geology of the 2nd level of the Highland mine, Ainsworth mining camp, Kootenay district; scale, 100 feet to 1 inch. ....	Geology
1785	Diagram showing geology of certain mineral claims of the Florence Silver Mining Company, Ainsworth mining camp, Kootenay district; scale, 400 feet to 1 inch. ....	Geology
1786	Diagram showing geology of the underground workings of the Florence Silver Mining Company, Ainsworth mining camp, Kootenay district; scale, 100 feet to 1 inch. ....	Geology
1787	Diagram showing the geology of the Sunlight and part of the Star mineral claims, Ainsworth mining camp, Kootenay district; scale, 300 feet to 1 inch. ....	Geology
1788	Diagram showing geology of the Ayesha mineral claim, Ainsworth mining camp, Kootenay district; scale, 300 feet to 1 inch. ....	Geology
1789	Diagram showing geology of the Spokane mineral claim, Ainsworth mining camp, Kootenay district; scale, 150 feet to 1 inch. ....	Geology
1790	Cross-section of vein at the face of lower tunnel of the Early Bird mineral claim, Ainsworth mining camp, Kootenay district; scale, 1½ feet to 1 inch. ....	Geology
1791	Diagram showing geology of the tunnel on the Crown mineral claim, Ainsworth mining camp, Kootenay district; scale, 40 feet to 1 inch. ....	Geology
1792	Diagram showing geology of the tunnel on the Albion mineral claim, Ainsworth mining camp, Kootenay district; scale, 75 feet to 1 inch. ....	Geology
BRITISH COLUMBIA AND ALBERTA		
1754	Upper Elk and Upper Highwood rivers; scale, $\frac{1}{250,000}$	Topography
ALBERTA		
1584	Blairmore; scale, $\frac{1}{62,500}$	Geology and topography
1803	Ribstone Valley anticline, townships 38, 39, 40, ranges 6, 7, 8, west of 4th meridian; scale, 3 miles to 1 inch. ....	Geology
1751	Wainwright, townships 38 to 46, ranges 5 to 10, west of 4th meridian; scale, 3 miles to 1 inch. ....	Topography
1752	Monitor, townships 30 to 40, ranges 1 to 5, west of 3rd meridian, and townships 30 to 40, ranges 27 to 29, west of 4th meridian; scale, 3 miles to 1 inch. ....	Topography
MANITOBA		
1763	Portion of Rex group of claims, Wekusko lake; scale, 200 feet to 1 inch. ....	Geology
1801	Reed and Wekusko Lakes regions; scale, 2 miles to 1 inch. ....	Geology

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Maps Published January 1, 1920, to March 31, 1921—*Continued*

Publication number	Title	Remarks
ONTARIO		
1766	Explored routes in a belt traversed by the Canadian National railways (between Penhurst and Longlac), Algoma and Thunder Bay districts; scale, 4 miles to 1 inch.....	Geology
1793	Matachewan, Timiskaming district; scale, 1 mile to 1 inch...	Geology
1798	Pyrite deposits (outcrops), lots 1 and 2, concession I, Blithfield township, Renfrew county; scale, 200 feet to 1 inch.....	Geology
1799	Graphite deposits, lots 17 and 18, concession III, Brougham township, Renfrew county; scale, 250 feet to 1 inch.....	Geology
1800	Molybdenite deposits, lots 8 and 9, concession XI, Brougham township, Renfrew county; scale, 250 feet to 1 inch.....	Geology
1807	Diagram showing location and structure of Dover oil and gas field, Kent county; scale, $\frac{3}{4}$ mile to 1 inch.....	Economic geology
1808	Block diagram illustrating the occurrence of gas and oil in the Trenton limestone of Dover West township, Kent county; scale, $\frac{1}{2}$ mile to 1 inch.....	Economic geology
1809	Three series of wells showing relative depths in Trenton, of occurrences of oil and gas.....	Economic geology
1811	Lead and zinc bearing veins, Dorion township and vicinity, Thunder Bay district; scale, 1 mile to 1 inch.....	Economic geology
1826	Oil and gas fields in parts of Kent and Essex counties; scale, 3.95 miles to 1 inch.....	Economic geology
1827	Dutton oil field, Elgin county; scale, 3,000 feet to 1 inch.....	Economic geology
QUEBEC		
1691	Buckingham; Hull and Labelle counties; scale, 1 mile to 1 inch..	Geology
1701	Northeast portion of New Quebec and Labrador; scale, 30 miles to 1 inch.....	Geology
1756	Beauceville, Beauce county; scale, 4,000 feet to 1 inch.....	Topography
1795	Portions of Maniwaki, Kensington, Egan, and Aumond townships, Hull county; scale, 1 mile to 1 inch.....	Geology
1822	North shore of gulf of St. Lawrence, sheet I: Seven Islands to Ouapitagone; scale, 12 miles to 1 inch.....	
1823	North shore of gulf of St. Lawrence, sheet II: Ouapitagone to Blanc-Sablon; scale, 12 miles to 1 inch.....	
NEW BRUNSWICK		
1833	Albert Mines oil-shale area, Albert county; scale, 800 feet to 1 inch.....	Geology
NOVA SCOTIA		
1707	New Glasgow, Pictou county; scale, 2,000 feet to 1 inch.....	Topography
1796	Malagash peninsula, Cumberland county; scale, $\frac{1}{2}$ mile to 1 inch..	Geology
1797	Malagash salt district, Cumberland county; scale, 800 feet to 1 inch.....	Geology
1814	Carleton-Kemptville gold area, Yarmouth county; scale, $\frac{1}{2}$ mile to 1 inch.....	Geology
1815	Plan and section of gold-bearing series, Cranberry head to Chegoggin point, Yarmouth county; scale, $\frac{1}{2}$ mile to 1 inch..	Geology
1816	Kemptville gold district, Yarmouth county; scale, 250 feet to 1 inch.....	Geology
1817	Carleton gold district, Yarmouth county; scale, 250 feet to 1 inch.	Geology
LABRADOR		
1699	Nachvak fiord; scale, 4 miles to 1 inch.....	Geology
1700	Komaktorvik fiord; scale, 4 miles to 1 inch.....	Geology

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## PHOTOGRAPHIC DIVISION

G. G. Clarke, Chief Photographer, reports that the following work was done by the Photographic Division during 1920:

Contact prints, ranging from 4 by 5 inches to 36 by 48 inches.....	12,579
Bromide enlargements, ranging from 4 by 5 inches to 40 by 72 inches..	429
Films and plates developed, ranging from 3½ by 4½ inches to 6½ by 8½ inches .....	3,485
Dry plate negatives, ranging from 4 by 5 inches to 11 by 14 inches	497
Wet plate negatives, ranging from 8 by 10 inches to 24 by 30 inches	165
Prints on zinc plates, ranging from 11 by 14 inches to 24 by 36 inches	42
Proofs from zinc plates, ranging from 11 by 14 inches to 24 by 36 inches	124
Photostat copies, ranging from 7 by 11 inches to 11 by 14 inches....	132
Lantern slides, ranging from 3½ by 4½ inches.....	634
Photographs and titles mounted.....	1,739

## DISTRIBUTION DIVISION

Wyatt Malcolm, Chief of the Division, reports that during the fiscal year ending March 31, 1921, 57,435 publications of the Geological Survey, exclusive of the French editions, were distributed. Of these 48,007 were distributed in compliance with written and personal requests, and 9,428 were sent to addresses on the mailing lists.

## LIBRARY

Mrs. F. E. Forsey, Librarian, reports that the additions to the library during 1920 were as follows:

Volumes received as gifts or exchanges, including reports and publications of foreign Geological Surveys, together with memoirs, transactions, and proceedings of the scientific societies of Canada and other countries .....	691
Books purchased .....	427
Periodicals subscribed for .....	172
Periodicals received as exchanges.....	49
Volumes bound .....	485
Pamphlets received .....	290
Maps received .....	319
Maps mounted .....	166

Grateful acknowledgment is made for volumes presented to the library by Sir William Ridgeway, H. F. Osborn, Frank Springer, D. B. Dowling, James Chumley of Glasgow, H. K. Swann, Louis Duparc, Geneva, Dr. Eugene Haanel, Dr. Lomer, Librarian of McGill University; also of photostat copies of valuable records of early travels, presented by the Archives Department, and the Geographic Board of Canada.

The Library is open to the public for reference during office hours, and an increasing number of visitors have availed themselves of this privilege, not only with regard to the books, but also in connexion with the collections of maps and photographs.



## VICTORIA MEMORIAL MUSEUM

*William McInnes, Director*

The erection of the Victoria Memorial Museum into a division of the Department of Mines, separate from the Geological Survey, is the first step toward the creation for Canada of a National Museum that will worthily represent her great natural resources.

As now constituted, the Museum includes Biological, Anthropological, and Palaeontological Divisions. The Biological Division which is under R. M. Anderson, zoologist, as acting chief, includes mammalogy, ornithology, and botany; the Anthropological Division under E. Sapir, ethnologist, covers the whole range of anthropology including archaeology; and the Palaeontological Division under Edward Kindle as Curator includes vertebrate and invertebrate palaeontology.

Owing to the destruction of the Parliament buildings by fire and the consequent necessity of providing housing for the legislature, the Victoria Memorial Museum was vacated and the large collections that had been gathered by the Geological Survey since the inception in 1842 were placed in storage. In the winter of 1920-21 the Session of Parliament was held in the new Parliament building and the Victoria Memorial Museum building became again available, in part, for the Museum. The whole building, which would be all too small to house adequately the exhibits and staff of a National Museum was, unfortunately, not available. One of the exhibition halls previously used was taken over by the National Gallery and the natural growth of the Geological Survey required the apportionment to that branch of a large part of the remaining space.

In the circumstances, therefore, it has been possible to give to exhibition purposes only one hall on the main floor and three on the second floor together with the rotunda on both floors.

An endeavour has been made to install in these halls the best biological, anthropological, and palaeontological exhibits that could be arranged under existing conditions. Many of these are of necessity placed in temporary cases and the halls are generally too crowded for effective display.

The congestion in the halls is apparent to the casual visitor and the unseen congestion—the housing of reference collections and the mass of study material, that in any museum constitute its most valuable possessions—is even greater.

The staff of the Museum divisions were fully occupied during the year in the discharge of the duties of their several positions. Field work in biology and anthropology was carried on in the summer months, and in the winter the results were worked up and prepared for publication or filing for reference.

The need for adequate provision for the proper preservation and storage of valuable collections of material is daily becoming more urgent and considerations of economy should not be allowed to so far influence us as to prevent this provision being made. Many of the specimens now on hand are unique and there is in private hands a large amount of material which would be turned over to the Museum for the benefit of the public if assurance could be given that it would be housed in such a way as to be accessible and safe.

The necessity for the curtailment of expenditure in every possible way in the public service is recognized; but it would be false economy that would detrimentally affect the country's progress, to neglect to provide accommodation to ensure the preservation of material that, once destroyed, can never be replaced.

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The auditorium, after being vacated by the House of Commons, was fitted by the Public Works Department with comfortable, fixed seats, accommodating 262; and the gallery was provided with temporary chairs seating 266. A projecting lantern and moving-picture machine made the room available for meetings of scientific societies and for lectures.

Advantage was taken of the refitted hall to hold a series of lectures for adults on scientific subjects by members of the staff of the department, and a series for school children on Saturday mornings. The children's series proved particularly popular the hall being filled to capacity at each lecture, by attentive and receptive children; and on many occasions was so crowded that it was necessary to repeat the lecture twice and even three times during the morning. The Publicity Bureau of the Department of Trade and Commerce helped materially to make the gatherings successful by providing an operator and suitable films.

In addition, permission was granted to various scientific societies, including the Royal Society of Canada, to use the room for meetings.

The department suffered a great loss by the death, on July 18, 1920, of John Macoun, one of the oldest members of the staff. Mr. Macoun joined the Geological Survey as botanist in 1882 and from then to the day of his death devoted himself untiringly to the botanical work of the department.

Through his love for the work, and unsparing efforts, the herbarium now holds an honoured place among the botanical collections in America. By his death and by the death of his son, James M. Macoun, who predeceased him by a few months, the science of botany in Canada has met with a loss than can hardly be over-estimated.

M. O. Malte, agrostologist of the Central Experimental Farm, has acted as honorary curator of the herbarium since Mr. Macoun's death.

## ANTHROPOLOGICAL DIVISION

### ETHNOLOGY AND LINGUISTICS

#### *Exhibits*

E. Sapir, Chief of the Division, reports that the Victoria Memorial Museum building, though no longer occupied by Parliament, has not been in such shape throughout the greater part of the year as to warrant its being formally thrown open to the public. However, visitors to the Anthropological hall have been rather numerous and always welcome. The hall adjoining this has been assigned to the Division of Anthropology for further exhibits. Lack of suitable cases makes it impossible for the present to install a permanent ethnological exhibit in this new hall, but the division is utilizing an old stock of small table-cases for a temporary exhibit of ethnological material from tribes of the plains and the western plateaus, two regions that had been hitherto unrepresented in our public collections. The archaeologist of the division, H. I. Smith, took charge of the supplementary exhibit and is preparing a popular guide-book to serve as a general introduction to the life of our Canadian aborigines, particularly from the point of view of their arts and handicrafts.

Acknowledgments are due to the following for donations of specimens or photographs to the Museum: W. B. Anderson, Iver Fougner, A. J. Matheson, Captain Mills, Geo. P. Phillips, R. Sutherland.

Four anthropological field trips undertaken during the summer evidence progress towards the restoration of pre-war conditions in the Division of Anthropology. Of these one was a combined archaeological and ethnological trip to Bellakula, B.C., undertaken by H. I. Smith. A second was an extensive archaeological field research in southwestern Ontario by W. J. Wintemberg. This trip, as well as the archaeological

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part of Mr. Smith's field work, are reported on under "Archaeology." C. M. Barbeau undertook an elaborate field reconnaissance of the social organization of the Tsimshian Indians of Upper Skeena river, B.C., continuing work carried out during a previous field trip among the Tsimshian tribes at Simpson. Finally, F. W. Waugh spent another summer among the Ojibwa of lac Seul, Ont.

E. Sapir spent the greater part of the year in linguistic researches. The large body of Nootka text material is being put in final shape for publication. Considerable progress was made on the grammatical analysis of the Nootka language. A review of Nootka ethnology for the general public was prepared in the form of an ethnological narrative centreing about the life of a single individual. This paper, entitled "The life of a Nootka Indian," was read in part before the Royal Society of Canada (May, 1920), and has been published in "Queen's Quarterly." In the course of the preceding year Dr. J. G. Wolf, interned at Kapuskasing, Ont., working under Dr. F. Beas' direction, had prepared on slips a preliminary dictionary of Wishram, based on Mr. Sapir's "Wishram texts" and on manuscript notes put at his disposal. These slips are carefully revised and supplemented by Mr. Sapir. Full dictionaries of the Chinookan dialects (Chinook, Kathlamet, Wishram) are likely now to be of more than ordinary interest in view of the surprising linguistic status of Chinookan revealed by Mr. Sapir's comparative researches, Chinookan proving to be a member of the Penutian group that extends in a broken line from southern California to British Columbia. Following up previous work on Indian kinship systems (Yana, Kootenay, Nass River), Mr. Sapir undertook a linguistic-sociological review of the kinship systems of Algonkin, Wiyot, and Yurok. The linguistic portion of this paper is completed and confirms Mr. Sapir's hypothesis of the Algonkin affinity of Yurok and Wiyot, two languages spoken in northwestern California. The sociological portion will throw light on a number of kinship developments within the enlarged Algonkin group. The paper on "Nass River terms of relationship" was published in the *American Anthropologist* (N.S., vol. 22, 1920, pp. 261-271). Two papers on the Yana language of California were prepared in the course of the year: "The fundamental elements of northern Yana" and "Text analyses of three Yana dialects." These are to appear in the University of California Publications in American Archaeology and Ethnology. Mr. Sapir has begun a general reconnaissance of the Indian linguistic groups ("stocks") north of Mexico to ascertain what reduction of the more than fifty stocks generally recognized is possible and what light may be thrown by the restored groupings on the earliest aboriginal movements of population. As a preliminary result he finds that it is possible to do with but six main morphologic-genetic groups, which may ultimately be somewhat further reduced. Five of these groups are represented in Canada. One of them, the Nadene (consisting of Haida, Tlingit, and Athabaskan), stands out very distinctly from all the rest and may represent a relatively late wedge from the Asiatic continent into an earlier American distribution of languages. Mr. Sapir is now planning to resume the intensive comparative study, undertaken some years ago, of the Nadene languages, and has made considerable progress towards the composition of a comparative Athabaskan dictionary, a necessary first step in the larger task. It is probable that both the general study of Indian stocks and the more detailed study of Nadene will result in new, and even unexpected, points of view on the linguistic affiliations and early history of the American Indian. A preliminary report on the classification of American languages was given in December, 1920, at the Chicago meeting of the American Association for the Advancement of Science, Section H. It was entitled "A bird's-eye view of American languages north of Mexico" and was illustrated by a coloured map.

Harlan I. Smith spent the period of June 2 to September at Bellakula, B.C., partly on an archaeological reconnaissance but mainly in order to study the material culture of the Bella Coola Indians, one of the most important of the West Coast tribes, but concerning whom relatively little has yet been published. Mr. Smith obtained

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very full information on the industrial life of the tribe. A considerable mass of information was also obtained on the material culture of the Carrier band dwelling near the Bella Coola reserves. Mr. Smith's researches were supplemented by a set of ethnological photographs and a valuable collection of ethnological objects.

C. M. Barbeau undertook a seven months' investigation in the field—from June, 1920, to January, 1921—of the ethnography of the Gitksan tribes of British Columbia. The five tribes to which he confined his researches are those of the headwaters of Skeena river, from Hazelton to the Groundhog district and Bear lake, a distance of about 200 miles. Two of these tribes, Qaldo and Anlagasemdekh, have now ceased to exist independently, and their members have scattered among their kinsmen of the more easily accessible villages of Kispayaks, Glen Vowell (a modern settlement), and Gitenmaks (Hazelton). The Kisgagas tribe, situated near the junction of Babine and Skeena rivers, is also dwindling in numbers, owing to the same general tendency to renounce isolation and old-time customs. Though his headquarters remained at Gitenmaks (Hazelton), he visited all the other tribes, with the exception of Qaldo. Kisgagas and Anlagasemdekh, being situated about 50 miles above Hazelton, on a trail, it was necessary to organize and equip a party for an expedition of about two weeks. A series of potlatches given at Hagwelgate—a Carrier village situated 4 miles from Hazelton, on Bulkley river—were observed and subsequently analysed with the help of participants; and photographs were taken both of a potlatch display and of a secret society (galuhlim) dance. Several other points in the ethnography of those tribes received attention.

D. Jenness, the anthropologist of the Canadian Arctic Expedition, spent the year working up the Eskimo data he had obtained. Two of his reports are now ready for publication, "The life of the Copper Eskimos," a manuscript of 500 pages, and "String figures of the Eskimos," a manuscript of 200 pages. A third report, on Eskimo folk-lore, with texts in the native language, is nearing completion. Mr. Jenness is at present chiefly engaged in working out his grammatical material from Barrow, the Mackenzie delta, and Coronation gulf. The two completed papers have been put into the hands of the Arctic Board, and their publication may be expected in the near future.

F. W. Waugh continued work on his monograph dealing with the folk-lore of the Iroquois. This volume will consist of a large series of folk-tales from the various tribes of the Iroquois Confederacy and of a discussion of such beliefs and practices as come under the general rubric of "folk-lore." During the summer Mr. Waugh spent about two and a half months among the Ojibwa of lac Seul in northwestern Ontario in continuation of work in the same region undertaken during the preceding season.

No anthropological publications have appeared in the course of the year. This failure to continue the Anthropological Series of memoirs and bulletins that was well under way before the war is due not to lack of material but to the present policy of rigid economy in publication expenditures. This policy, if continued in its present form, threatens to render all but useless the work of the Division of Anthropology except insofar as the department allows its anthropological manuscripts to be published by other institutions.

Two manuscripts on the Eskimo, submitted by D. Jenness for publication by the Arctic Board, have been referred to.

The following manuscript, secured as a gift from Dr. F. G. Speck in 1915, has been returned to him for publication elsewhere: "Studies of the Beothuk and Micmac of Newfoundland," 66 pages and 4 negatives.

A portion of the large ethnological manuscript on the Dakota of Manitoba, by Dr. W. D. Wallis, transferred in 1918 and 1919 to the American Museum of Natural History, New York, has been published by that institution in the course of the year: "The Sun Dance of the Canadian Dakota," by W. D. Wallis. (Anthropological Papers of the American Museum of Natural History, vol XVI, part IV, 1919, pp. 317-380).

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## ARCHAEOLOGY

Harlan I. Smith reports that the exhibits belonging to the Geological Survey, Canada, illustrating the prehistoric culture of Canada, and including the earliest known Canadian art and material handiwork, are now open to the public in the Victoria Memorial Museum.

More space is urgently required in order to exhibit the representative selection of the archæological remains of each of the culture areas of Canada, and especially to make available to commercial designers and manufacturers material which they now express a keen desire to use in producing distinctively Canadian manufactures, to take the place of manufactures involving European decorative designs.

Photographs, rather than drawings, of actual specimens of every type of prehistoric Canadian art, should be prepared as soon as the photographs can be made, to be framed as economic exhibits for Canadian manufacturers and designers, to be given or loaned to the museums, schools of design, art schools, and to various exhibitions throughout Canada. As soon as it is possible to have the services of a plaster worker, casts of these specimens should be made in order that they may be assembled for such an economic exhibit in the Museum, and also for distribution.

A new lecture is now available on Prehistoric Indian art as a source for distinctively Canadian manufactures, illustrated with lantern slides of over four hundred objects.

A more complete stock of lantern slides is required, in order to be able at all times to adequately present the results of archæological work in Canada by means of public lectures. These may be made largely from the Museum specimens and negatives.

Acknowledgments are due to the following for donations to the Museum: Chapleau, S. J., Clayton, D., Clayton, Mrs. E., Drake, T. G. H., Embury, W. J., Girling, Rev. H., Gordon, H., Gordon, E., Hobson, W. B., Jacobsen, B. F., McMullin, F. E., Nijgard, M., Oatman, A., Sutherland, R., Uren, C., Uren, G., Wood, F. S.

Archæological reconnaissance was carried on in the Bella Coola area, in British Columbia, by Harlan I. Smith, and both reconnaissance and intensive excavation was carried on in southwestern Ontario by W. J. Wintemberg.

Mr. Smith was in the field carrying on archæological reconnaissance and ethnological work in the Bella Coola area, British Columbia, during June, July, and August. The Bella Coola Indians are an isolated group of tribes speaking a Salishan dialect, cut off from the larger body of dialects of the same stock, living to the east, in the interior of southern British Columbia, by the Carriers and Chilcats, both of the Athabaskan stock. On the north, west, and south, their neighbours are of a still different linguistic stock—the Wakashan. The Bella Coola are believed to have come from the interior near where their kindred in language now dwell, and to have taken up some of the arts and customs of their sea-coast neighbours. Certainly some of their art work seems to be a poor imitation of that of the neighbouring coast. They met white men first when Mackenzie made the initial journey across Canada to the Pacific coast in 1793, and still treasure the experience. The present Bella Coola are assembled in three main villages. Mr. Smith located the old village sites and many small sites. Some archæological specimens were collected, petroglyphs and pictographs in red were located, and sketched or photographed, and photographs were taken of all the specimens in three local collections, which probably represent a majority of the less perishable artifacts. These consist chiefly of points clipped from obsidian, celts or adzes, simple hand-hammers oval in section, grooved hammer-heads, some of them sculptured, semi-cylindrical game stones, and perforated stone game disks.

There is no dearth of village refuse in which to carry on future intensive excavation. Permission was secured to excavate some of the best of the sites. No inten-

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sive excavation has ever been carried on in the Bella Coola area, which because of its isolation and neighbours presents problems as to their earlier culture and that of their possible predecessors in the area. The material culture of the modern Indians of the region is expressed chiefly in perishable material such as wood, bark, and skin, thus, if the earlier culture were similar we would not expect many artifacts other than those mentioned to endure.

Incidentally a large amount of data was secured regarding the knowledge possessed by both the Bella Coola Indians and visiting Carrier Indians in regard to all the plants, animals, and minerals of the area, a complete knowledge of which would, of course, embrace that of their entire material culture.

W. J. Wintenberg was in the field in southwestern Ontario from July 19 to October 29. He made notes of the more important specimens in Hamilton and other places as far west as Detroit river. He discovered three small Algonkian village sites and visited an ossuary and several supposed artificial mounds near Cayuga, and examined an Algonkian and an Iroquoian site in the vicinity of Port Dover, Norfolk county. He found six large village sites and four smaller sites, apparently of one culture, and two small sites of another culture, near Norwich, Oxford county.

An intensive exploration was made of one of these large sites, known as the Uren site, covering about 20 acres on the farm of Joseph N. Uren. Here were twenty refuse heaps 17 inches high or less. Many artifacts of stone, bone, and antler, and a few of shell, were found. The culture is similar to that of Neutral, Iroquoian sites, elsewhere in southwestern Ontario, except most of the ornamentation on the pottery and the shape of the earthenware pipes. A mixture of Algonkian and Iroquoian styles of ornamentation is found on some pieces of the pottery. Typical Iroquoian styles are found on a few fragments, and typical Algonkian on others. The earthenware pipes are mostly simple, elbow forms, with short stems, none of trumpet shape being found. Evidences of pipes are not numerous, as they are on Iroquoian sites in general. Charred corn and sunflower seeds, many unnotched triangular projectile points chipped from stone, a few notched points, and a bead made of a small ocean shell, were found. No traces of palisades, houses, graves, or other structures were found, although human remains have been plowed up on nearby sites.

Sites in the vicinity of Otterville, Sweaborg, and Tillsonburg, in Oxford county, and Aylmer, St. Thomas, Fingal, and Wallacetown, in Elgin county, were inspected.

To summarize the work in Ontario, Mr. Wintenberg inspected every important site in the tier of Ontario counties bordering lake Erie, except those in Welland county, a large fortified village site, near Clearville, which has been much disturbed by collectors, and one on the McGeachy farm near Chatham. The sites are shallow. Some are of Algonkian culture; others of Iroquoian. In previous years he has inspected every known site in the tier of counties along the St. Lawrence and lake Ontario, from the mouth of Ottawa river to Trenton. This area includes both shallow and deep Iroquoian sites, shallow Algonkian sites, and sites of several undetermined cultures. Intensive exploration was carried on in a typical Iroquoian site near Roebuck in 1912 and 1915; and in the Uren village site of Iroquoian culture, strongly flavoured with Algonkian, this year. There remains to be explored in Ontario the tier of counties from Trenton to Welland county inclusive, and the counties north of the tier bordering the waters of lakes Erie and Ontario, and the St. Lawrence.

The results of intensive work in each linguistic and culture area are useful as standards of reference for other material found in the same area. They are to archaeology as topographic control stations are to topography, and faunal lists of a section of one horizon are to palæontology.

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Intensive archaeological exploration has been carried on in Canada as follows:

In the Algonkian area at Merigomish, N.S., by Mr. Smith, for the Survey.

In the Iroquoian area at Roebuck, Ont., by Mr. Wintemberg, for the Survey.

In the Salish area of the interior of B.C., by Mr. Smith, for the American Museum of Natural History, New York.

In the Salish area of the southern coast of B.C. (a different culture from that of the Salish area of the interior), by Mr. Smith, for the American Museum of Natural History, New York.

In the Haida area of the northern coast of British Columbia, by Mr. Smith, for the Survey.

There are five linguistic areas in British Columbia, and only five in all the rest of Canada. Four are on the coast of British Columbia. Consequently it is a region which should receive a large proportion of the archaeological exploration of Canada.

## FOLK-LORE (1914-1920)

(*C. M. Barbeau*)

The American natives, in their prolonged and intimate contact with their white neighbours, have assimilated a large number of European notions and technical processes. These intrusive materials are now interwoven in the fabric of aboriginal culture, and it is not always possible for the ethnologist to disentangle the elements and discover their proper historical source. We cannot yet determine, for instance, to exactly what extent the technique of basketry, decorative patterns or designs, woven bands and sashes has been modified under extraneous influence. Folk-medicine, superstitious notions, mythology, and folk-tales have also absorbed a great deal of what at first was not their own.

Field ethnographers, in their hurried gathering of quickly vanishing data, could not deeply concern themselves with such intricate problems. But the time has come when comparative studies force themselves to the foreground. What is aboriginal in origin or what is European are questions that incessantly crop up. For a sound comparative analysis we, of course, are in need of abundant materials from both sources. Much information is available in European museums and libraries, but nowhere are the materials more plentiful, more easily accessible, and more apt to the elucidation of historical problems that concern us than in the very field where the Indians came into contact with the white invaders of various nationalities. We have gradually given more attention, since 1914, to some phases of the European folk-lore lying easily within our reach. Encouraging results induced us to prosecute further our research in a newly discovered domain. From French folk-tales collected at Indian Lorette and also diffused among other American tribes, we passed to folk-songs, technology, and folk-traditions generally, even though in most cases they bore no relation to any Indian data. The impetus has gradually gained momentum until it became clear to us that the resources of Old World folk-traditions in America—be they English, French, Gaelic, Scandinavian, or German—are still vast, unexplored, and a worthy object of study, not only because they may have casually influenced the aboriginal culture, but also for their own sake.

Among the fields for investigation that have come to our attention in Canada the most fruitful are the French, the English (Scotch, Irish), the Gaelic (Scotch), and the Scandinavian. Vast collections of French data have been assembled and are now in the keeping of the Anthropological Division. The work has also been initiated in the English districts, especially Ontario, with promising results.

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## Folk-Lore Collections

*(French)**The Barbeau (C. M.) Collection—*

- 250 folk-tales, from the counties of Quebec, Beauce, Charlevoix, Chicoutimi, Kamouraska, Temiscouata, and Gaspé;
  - 1,885 song texts, from the same counties;
  - 1,618 song melodies (of the same texts) recorded on the phonograph;
  - 146 folk-anecdotes, mostly bearing on ancient beliefs and customs, recorded in the counties of Quebec, Temiscouata, Gaspé, Beauce, and Kamouraska.
  - 730 photographs of technical processes, objects, and of people (Quebec, Montmorency, Charlevoix, Chicoutimi, Temiscouata, and Beauce counties);
  - 75 dance tunes, sung or played on the violin, 65 of which were recorded on the phonograph.
- Also considerable materials bearing on the folk technology, "blason populaire" (nicknames), customs, beliefs, sayings, rhymes, and language of the same counties of Quebec.

*The Massicotte (E. Z.) Collection—*

- 1,727 (possibly more) song texts, collected in Montreal, from singers born in various Quebec districts; Beauharnois, Champlain, Russell, Prescott, Kamouraska, and others;
  - 1,360 song melodies (of the same texts) recorded on the phonograph;
  - 111 beliefs and sayings, collected in Three Rivers (Que.);
  - 58 popular remedies;
  - 175 formulæ, rhymes, and riddles, from western Quebec;
  - 10 (approximately) folk-tales, anecdotes, and texts of various kinds;
  - 30 (approximately) violin and accordeon dance tunes;
  - 20 photographs of old buildings in Montreal; 121 photographs taken in Champlain county.
- Also materials bearing on technology, games, bibliography, and other matters.

*The A. G. Collection—*

- 248 song texts from Portneuf, Nicolet, and other counties;
- 42 song melodies recorded by ear.

*The Lambert (A.) Collection—*

- 141 song texts mostly from Berthier, Que., with appended melody recorded by ear;
- 15 folk-tales;
- 3 other spoken texts;
- 18 short satire songs.

*The Barbeau-Wyman Collection—*

- 60 songs from Temiscouata county, recorded both in text and on the phonograph.

*The Tremblay (Julies) Collection—*

- 59 song texts recorded in Ottawa;
- 57 melodies of the same songs;
- 2 anecdotes.

*The Wyman (Lorraine) Collection—*

- 18 songs from Percé (Gaspé) recorded in text, the melodies by ear.

*The Cyr (Vre. C.) Collection—*

- 56 song texts, recorded at Cowley (Alberta).

*The Tremblay (Malvina) Collection—*

- 12 folk-tales from Chicoutimi.
- Also many folk remedies, sayings, fragments of songs, and expressions.

*The Lanctôt (Gustave) Collection—*

- 8 folk-tales from Laprairie (Quebec);
- 9 formulæ;
- 20 song texts, also from Laprairie.

*The Lanctôt-Barbeau Collection—*

- 50 song texts, copied from a manuscript (Deux-Montagnes, Quebec); 25 of which were recorded on the phonograph.

*The Morin (Victor) Collection—*

- 4 folk-tales and formulæ from St. Hyacinthe (Quebec).

*The Mercure (Geo.) Collection—*

- 7 anecdotes from Portneuf county and La Pointe-Gatineau;
- 3 song texts.

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*The Cloutier (J. E. A.) Collection—*

- 5 folk anecdotes from L'Islet county (Quebec);
- 2 song texts.

*The Bolduc (Evelyn) Collection—*

- 3 folk-tales from Beauce county (Quebec).

Also from *Beaudry (Laurent)*, *Guillot (A.)*, *Gareau (J. B.)*, *Gagnon (Alphonse)*, *Mrs. A. J. Mount-Duckett*, and others—

A certain number of folk-songs, sayings, folk-tales, and manuscripts.

*Old manuscript song books—*

- 1 "cahier Mizaël Hamelin" (1860, Quebec), deposited by Mr. E. Z. Massicotte;
- 2 old song-books dated 1820-30, deposited by Mr. Massicotte;
- 1 old manuscript of dance melodies, copied circa 1830, deposited by Mr. Massicotte;
- 2 books of literary songs copied in 1828, deposited by Mr. Massicotte;
- 3 song books from Sister Ste. Georgia, circa 1878, deposited by C. M. Barbeau;
- 3 manuscript books of literary sacred songs, etc., as known about 1878, deposited by C. M. Barbeau.
- 1 song book given by Mr. Benjamin Sulte to C. M. Barbeau and also deposited with the others;
- 1 song book loaned for taking copies of songs noted down about 1860, by Mrs. A. J. Mount-Duckett.

(It may be noted that comparatively few of these manuscript songs are actually old folk-songs. However, the books serve to indicate at what date some literary songs were introduced into Canada.)

*Totals (approximate)—*

- 4,140 song texts, not including those found in the manuscript books, in clippings from old newspapers and other sources;
- 3,037 song melodies recorded on the phonograph;
- 278 song melodies, recorded by ear;
- 280 folk-tales;
- 165 anecdotes;
- 890 photographs;
- A few hundred rhymes, formulæ, and kindred materials;
- 105 dance melodies, most of which were recorded on the phonograph;
- About 200 sayings, beliefs, and
- About 100 popular remedies;
- Also abundant other data on other topics.

*(English and Irish)**The Waugh (F. W.) Collection—*

- 838 formulæ, omens, beliefs, rhymes, and riddles, recorded in Ontario;
- 5 songs and ballads;
- 16 "noodle" stories.

*The Wintenberg (W. J.) Collection—*

- 653 rhymes, omens, sayings, games, and kindred material from various Ontario counties;
- A few rigmaroles, and tales;
- 15 songs and ballads.

*The Barbeau (C. M.) Collection—*

- 41 folk-songs with texts and phonograph records (Tadoussac and other parts of Quebec, Ottawa, and British Columbia);
- Formulæ, sayings, and kindred material.

*The Bleakney (F. E.) Collection—*

- 23 songs, formulæ, and games, from Ottawa.

*The Mount-Duckett (A. J.) Collection—*

- Songs copied from an old manuscript book, written about 1860, in western Quebec, not many of which are folk-songs.
- Also a few formulæ and kindred material.

*(English-Scandinavian)**The Teit (J. A.) materials—*

- "Water beings in Shetlandic folk-lore, as remembered by Shetlanders in British Columbia."

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It may be noted that, as folk-lore work had at first no official status in the Anthropological Division, we enjoyed only to a very limited extent the financial support of our institution. Many of the collections have been made privately and without financial help. In the case of Mr. Massicotte, a phonograph, phonograph blanks, and stationery were furnished. And in the summer of 1920, a small appropriation from the Geological Survey, Canada, enabled him to carry on some investigations in Champlain county, Quebec. It was chiefly through personal encouragement, correspondence, and enthusiasm that collaborators were induced to collect for us or to furnish their materials, which are now stored at the Victoria Memorial Museum. As to the writer's surveys (carried on in periods of from two weeks to three months, in 1914, 1915, 1916, 1918, 1919), two of the expeditions were at his own expense, and the three others were partly subsidized by the Geological Survey.

Our task was not complete with the collection of materials. Provision had to be made also for publication. The American Folk-Lore Society, through its editor, Dr. Franz Boas, welcomed our manuscripts for *The Journal of American Folk-Lore*, with the request that we raise funds corresponding to the additional expense incurred. We, therefore, organized the Quebec (in 1915) and Ontario (in 1918) Branches of the American Folk-Lore Society, and managed in various ways to gather the necessary financial help.

## PUBLICATIONS

The following articles and publications, marking various stages in our folk-lore enterprise, have been issued since 1916.

"Le folklore canadien-français" by C. M. Barbeau. (*Mémoires de la Société royale du Canada*, mars 1916, pp. 450-481.)

The French volume of *The Journal of American Folk-Lore* for 1916, No. CXI, pp. 1-154, including: 47 folk-tales from Quebec, "Contes populaires canadiens, première série," by C. M. Barbeau. . .; "Fables, contes et formules," by G. Lanctôt.

"Les métamorphoses dans les contes populaires canadiens," by C. M. Barbeau (*Mémoires de la Société royale du Canada*, mai 1916, pp. 143-160).

"Les traditions orales françaises au Canada," by C. M. Barbeau (*Le Parler Français, Quebec*, mars 1917, pp. 300-318).

The French volume of *The Journal of American Folk-Lore* for 1917, No. CXV, pp. 1-160, including: 27 numbers (folk-tales and rigmaroles) of "Contes populaires canadiens, seconde série," by C. M. Barbeau, and 4 numbers, "Facéties et contes canadiens," by Victor Morin.

"Le pays des gourganés," by C. M. Barbeau (*Mémoires de la Société royale du Canada*, mars 1918, pp. 193-225).

"Nos traditions orales," by C. M. Barbeau (*Revue canadienne*, Montreal, Jan. 1918, pp. 24-33).

Canadian Folk-Lore, pp. 1-201 (reprinted from *The Journal of American Folk-Lore*, vol. 31, for 1918), containing contributions by F. W. Waugh, W. J. Wintemberg, C. M. Barbeau, J. A. Teit, and F. Eileen Bleakney.

The fourth Canadian number of *The Journal of American Folk-Lore*, for 1919, No. 123, pp. 1-184, including: Chants populaires du Canada, première série" by E. Z. Massicotte and C. M. Barbeau; "Contes populaires du Canada, troisième série," by E. B., M. T., and C. M. B.; "Croyances et dictons populaires," by E. Z. M.

"The field of European folk-lore in America" presidential address to the American Folk-Lore Society, for 1918 (printed in *The Journal of American Folk-Lore*, April-June, 1919, pp. 185-197).

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"Les veillées du bon vieux temps," printed under the auspices of the Montreal Historical Society, 1920; pp. 1-110.

The fifth Canadian number of *The Journal of American Folk-Lore*, for 1920, No. 129, including "Anecdotes populaires du Canada, première série," by C. M. Barbeau, Georges Mercure, and J. E. A. Cloutier.

The sixth Canadian number of *The Journal of American Folk-Lore*, for 1920, No. 130, including French nursery rhymes, folk-songs, "blason populaire" and photographs, by E. Z. Massicotte, Loraine Wyman, Gustave Lanctôt, C. M. Barbeau, and others.

## BIOLOGICAL DIVISION

The members of the staff of the Biological Division since their return to the Victoria Memorial Museum in May, 1920, have been occupied in the fabrication and installation of exhibition groups in the Museum halls. Sufficient progress was made in this work to permit of the halls being opened to the public during the summer, and work is in progress on additional groups which will be placed on exhibition as they are completed. R. M. Anderson, zoologist, Acting Chief of the Division, devoted his time to the administrative work of the division; to the determination and rearrangement of the large mammal collection on hand; and to the correspondence of the division which is always voluminous. Much of Dr. Anderson's time was devoted also to editing the scientific reports of the Canadian Arctic Expedition, of the Southern Division of which he was chief.

P. A. Taverner, ornithologist, and C. H. Young, who acted as his assistant, spent part of the summer of 1920 in field work in the province of Saskatchewan. They succeeded in making a good representative collection of the birds of the districts of Last Mountain and Kutawagan lake. In the late summer Mr. Taverner with Mr. Lloyd of the Department of Parks Branch, made an ornithological reconnaissance of the provinces of Saskatchewan and Alberta, for the purpose of gaining a general knowledge of the faunal conditions in those provinces.

The report of Mr. Taverner, published in 1919, on "Birds of eastern Canada" has been exhausted—both English and French editions—and a second edition is now going through the press. The cardboard-covered copies will be sold at 50 cents and the cloth-covered at \$1.00.

## BOTANICAL DIVISION

In May, 1920, the herbarium and offices of the division were removed from temporary quarters in the Lowe-Martin Building on Nepean street, which had been occupied for over two years, to the Victoria Memorial Museum.

M. O. Malte, agrostologist, Central Experimental Farm, and honorary curator of the herbarium, has exercised a general supervision over the work of the division since the death of J. M. Macoun.

A large collection of botanical specimens was received from Finland, also 649 sheets of plants from the United States and a small collection from Quebec. Many botanists and botanical students have taken the benefit of the herbarium during the year for purposes of study and for the comparison of material.



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## MINES BRANCH

*John McLeish, Acting Director*

The activities of the Mines Branch were carried on as usual, during 1920, for the greater part of the year under the direction of Eugene Haanel under whose able administration the Branch was organized in 1907 as one of two main branches of the Department of Mines. After nineteen years' service, six years as Superintendent of Mines in the Department of the Interior and thirteen years as Director of Mines Branch, Department of Mines, Dr. Haanel because of failing health accepted retirement from active service and was relieved of duty on December 15, 1920.

On the organization of the Mines Branch in 1907 the staff comprised 21 persons, of whom 7 had been transferred from the Geological Survey, 6 constituting the staff of the Assay Office at Vancouver and 8 the staff of the former Mines Branch of the Interior Department. Of these 21, 13 were technical officers including administering officers, engineers, chemists, and assayers.

In 1920 the staff had increased to 98, of whom 35 were technologists including engineers, chemists, and assayers, 22 clerks, and 41 mechanics, labourers, laboratory assistants, messengers, etc.

Investigations of the mineral resources of the country have been continued as usual to the fullest extent permitted by the available technical staff. But it must frankly be stated that although during the past few years the growth in production and utilization of mine products has been rapid and the demands upon the Department in respect thereto have proportionately increased, the department has been unable to meet those demands owing to the numerous resignations from an already too limited staff.

During 1919 the Mines Branch lost through resignations the services of G. C. Mackenzie, Chief of the Ore Dressing and Metallurgical Division, after ten years service; R. E. Gilmore, research chemist, and T. W. Hardy, F. W. Baridon, and B. P. Coyne, assistant chemists.

During 1920, resignations were submitted by John Blizzard, technical engineer in the Fuel Testing Division; K. A. Clark, Chief of the Road Materials Division; R. C. Cantelo, assistant chemist, Fuel Testing Division; Miss M. Young, technical assistant, ceramic laboratories; Wm. Campion, mechanical draughtsman; Miss Westman, library assistant. In March, 1921, Edgar Stansfield, chief engineering chemist of the Fuel Testing Laboratory, resigned.

The loss which the department suffers through the resignations of long-experienced and qualified investigating engineers and research workers is perhaps not fully realized. Such investigators cannot readily be replaced from outside the government service and the resignations of junior as well as senior investigators has militated against the availability of men for promotion. Sufficient recognition has not been, and is not being, given to the value of training and experience; the loss of the experienced research worker means the loss of much time and the cost—or a very inadequate return for—the training, as compared with the return that would accrue with the retention of the officer's services.

Only a small portion of the demands made upon the department for investigations can be undertaken and the services of the engineering staff are in constant demand for information and consultative advice. The necessity for special investigations has been such that much too frequently it has been necessary to set aside and defer one investigation already begun in order to take up another more pressing. As a result several engineers have much uncompleted work on hand, a condition which is neither fair to the officer concerned nor to the interested mining public, and a condition which can be remedied only by increased appropriation and staff.

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There are many directions in which the functions of the Mines Branch could with great value to the public interest be carried out much more thoroughly and on a larger and broader basis, but as the present does not seem an opportune time for increased appropriations and as the process of revision of departmental classification and organization is still under way, the subject need not at this point be further enlarged upon.

### METAL MINES DIVISION

A. W. G. Wilson, Chief of the Division, has been engaged for some years in the preparation of a comprehensive review of the development of chemical and metallurgical industries in Canada. The investigations upon which this review is based were undertaken to ascertain the nature and extent of the market demands in Canada for minerals and mineral products, and more especially chemical products made from minerals. It is known that Canadian industry requires a great variety of products made from minerals. The demand created by these requirements is satisfied in part by native products, but large quantities of foreign products also are imported. A knowledge of the requirements of industry is necessary before full and intelligent advantage can be taken of our own natural resources. The report now in preparation by Mr. Wilson attempts to review the whole field of industry, as developed in Canada.

A. H. A. Robinson has been in charge of magnetometric investigations of iron ore deposits for some years. His services were loaned to the Department of Mines of Ontario during the months of March and April for the purpose of making a special magnetic examination of an alleged iron-bearing area at Kashaweogama lake.

During the regular field season nearly four months were devoted to the investigation of our titaniferous iron resources and the collection of samples for chemical investigation and analysis. The balance of the year was spent in office work.

### NON-METALLIFEROUS MINES DIVISION

Howells Frechette, Chief of the Division, had undertaken in 1919 an investigation of the mineral pigments of eastern Canada and many deposits in Quebec were examined and reported upon. In 1920 the work was continued by him in Quebec, New Brunswick, and Nova Scotia. Practically all known deposits of iron oxide and iron-manganese oxide pigments in these provinces were examined and sampled. Much laboratory work has been conducted on the samples collected for the purpose of determining the nature of the pigments and the colours procurable from them by various methods of calcination.

H. S. Spence was engaged in gathering further data on barytes, talc, and fluorite, for the purpose of reports on these minerals. Consequent upon inquiries by the Imperial Mineral Resources Bureau regarding bentonite in Canada, Mr. Spence was instructed to visit, also, the known occurrences of bentonite in Alberta and British Columbia and to secure all the data possible regarding their extent and potential economic importance. Samples were secured in the various localities visited, and investigations of the physical and chemical properties of bentonite are being conducted in the Mines Branch laboratories.

L. Heber Cole was engaged from May 26 to October 20 on a continuation of the investigation of the structural materials along St. Lawrence river. During the first part of the season work was carried on in the vicinity of Cornwall, after which the area situated between Morrisburg and Prescott was examined. The work in the latter part of the season was carried on in the counties of Beauharnois, Huntingdon, Vaudreuil, and Soulanges, province of Quebec.

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Joseph Keele was associated with Mr. Cole in this work and a final report has been prepared for the Dominion Power Board at whose request the work was undertaken.

At the request of the Parks Branch of the Department of the Interior, S. C. Ells was instructed to make a further, more detailed examination of the bituminous sand deposits within the areas reserved for the use of the Parks Branch to determine the extent and quality of the sands that are available for mining, and the nature and thickness of the overburden. On the completion of this examination a short period was spent by Mr. Ells in visiting various outcrops of bituminous sand in the McMurray district with a view to making a provisional classification of the various sub-areas represented by these outcrops.

## MINERAL RESOURCES AND STATISTICS DIVISION

The staff of this division has as usual been continuously occupied with the duties involved in the collection of statistical and other data respecting the mining and metallurgical industries of Canada, the preparation of the annual reports on mineral production, trade and consumption, supplemented by the preparation of numerous special memoranda, for the information of correspondents, or other government departments, respecting the occurrences of mineral resources and their utilization.

A considerable portion of the time of the Chief of the Division during the past two years has been taken up with duties relating to reclassification and with the duties of the Acting Directorship of the Mines Branch. On this account and to facilitate the more prompt publication of the final mineral-production record the Annual Reports on Mineral Production in 1918 and 1919 were submitted for publication in greatly abbreviated form.

In the completion of the final reports on mineral production A. Buisson has again compiled the statistics with respect to metals and metallic ores, and has prepared the report on production of gold, silver, copper, lead, nickel, zinc, and other miscellaneous metals. He has also revised the list of "Metal Mines."

J. M. Casey has, as usual, compiled all the statistics of the production of non-metalliferous products and structural materials, as well as the records of imports of mineral products, and has prepared for printing the various lists of mine and quarry operators, with the exception of the "Metal Mines" and "Metallurgical Works" lists.

## MINERAL RESOURCES INDEX AND RECORDS

Some progress has been made in the development of the Mineral Resources Index referred to in the Summary Report of the Mines Branch for 1919 and previous years and more completely described in the final Report of the Munition Resources Commission, pages 204-208.

## NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES

The Department of Mines again shared with the Water Powers Branch of the interior Department a booth space at the Sixth National Exposition of Chemical Industries held at New York, September 20-25. A brief pamphlet on "The Mineral Resources and Mining Industry of Canada" was prepared for special distribution at the exhibition.

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## CO-OPERATION WITH THE DOMINION BUREAU OF STATISTICS IN THE COLLECTION OF MINERAL PRODUCTION STATISTICS

Pursuant to an arrangement entered into with the Dominion Bureau of Statistics, the complete files of statistical production records for the years 1917, 1918, and 1919 collected by the division were made available to the Dominion Bureau of Statistics, of the Department of Trade and Commerce.

The Statistics Act of 1918 provides for the collection by the Dominion Bureau of Statistics of statistics of production of industry, including the products of all mines and quarries, etc., and the Governor in Council has approved of the centralization of collecting agencies in the bureau.

Arrangements were made in order to effect the transfer of work with the least confusion, for the completion of the collection of statistics covering the year 1920 by the Mines Branch staff, with whom a qualified technical officer of the bureau was to be associated so as to become familiar with the details of method and practice involved; reports on production in 1920 to be completed by the Mines Branch, the Dominion Bureau then to make all necessary preparation for the collection of the statistics of production covering the year 1921, and the collection of monthly records of production of pig iron and steel.

All statistical data thus collected by the Dominion Bureau of Statistics is to be placed at the disposal of the Department of Mines for information and record and for use in the compilation of reports on mineral resources.

## ORE DRESSING AND METALLURGICAL DIVISION

On April 1, 1920, W. B. Timm, who was Superintendent of the Ore Dressing and Metallurgical Laboratories for a number of years, and who was Acting Chief of the Division during 1919 and the first three months of 1920, was promoted to Chief of Division.

R. K. Carnochan, assistant mining engineer, ably assisted in the work of the laboratories in carrying out the test work during the year.

The work of the chemical laboratories of the division was performed by H. C. Mabee and R. J. Traill.

No new appointments were made and no temporary assistants were secured to replace the resignations from the staff in 1919. The work of the laboratories was curtailed by not having the necessary technical officers to conduct the test work on hand.

In February a fire destroyed a portion of the laboratories, offices, and workshops, and held up the experimental work to some extent until the buildings could be rebuilt. In the meantime the chemical work was transferred to the chemical laboratories, Sussex street.

During the calendar year, the work consisted entirely of experimental testing of Canadian ores and minerals, and of investigations of the application of ore dressing and metallurgical processes. Twelve ore shipments were received; the test work on some of these is being carried into 1921, and a number of minor tests were conducted.

Mr. Timm visited the sampling plant and testing laboratories of the Ontario Government at Cobalt, Ont., and the Haileybury School of Mines laboratories at Haileybury, Ont., in connexion with the establishment of experimental laboratories in British Columbia. He also visited the Electro-Tin Smelting and Refining works at Brantford, Ont.; the laboratories of the Toronto Power Company, where experimental work was being conducted on the electric smelting of copper, lead-zinc ores and concentrates, and the L. J. Rogers laboratories, Toronto, where flotation work was being conducted in connexion with the application of non-oil flotation to Canadian ores.

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## FUELS AND FUEL TESTING DIVISION

B. F. Haanel, Chief of Division, reports that the Division of Fuels and Fuel Testing was very seriously handicapped during 1920 by depletions in the engineering and chemical staff. John Blizard, technical engineer, resigned May 1, 1920, to accept a position as fuel engineer with the Bureau of Mines, Washington, D.C. E. S. Malloch, assistant technical engineer, was incapacitated for practically nine months by serious illness. Edgar Stansfield, chief engineering chemist, devoted the major portion of his time to the work of the Lignite Utilization Board to which he has been formally attached. R. C. Cantelo, chemist, resigned at the end of February, and neither this vacancy nor that of the two chemists who resigned in 1919—R. E. Gilmore and T. W. Hardy—was filled during the calendar year. It was consequently impossible, as it was in the previous year, to carry out the programme for which money had been provided.

On March 31, 1921, Mr. Stansfield resigned from the staff of the Division of Fuels and Fuel Testing, Mines Branch, to assume the position of Industrial Research Chemist in the University of Alberta, Edmonton.

## INVESTIGATIONS PLANNED

The appropriations for 1920-21 provided for important research work in connexion with fuels, namely—an investigation concerning the combustion of various fuels in furnaces, boilers, etc., for industrial and domestic purposes; the retorting of peat and other fuels high in volatile matter, for the recovery of oils; and the continuation of the investigation now under way concerning the distillation of oil-shales. It is also planned to collect information concerning the methods which are now being employed for utilizing fuels for the production of power for general industrial purposes in Canada and for heating purposes. The necessity for conducting such an investigation was stated by Mr. Haanel in memoranda in which it was pointed out that certain economies in the use of fuels for the generation of power and for general heating purposes might be effected through the erection of central heating and power plants strategically situated with respect to industries and thickly inhabited communities, and that in certain instances hydro-electric energy might be substituted to advantage for steam-power plants now in existence. Without the information which such an investigation should afford, it will be impossible to make recommendations regarding means and ways for more efficiently using fuels for various purposes. Although such an investigation has been planned for some time it has up to the present been impossible to undertake it on account of the depletion of the engineering staff.

## DEPLETION OF STAFF

The depletion of the chemical staff also necessitated the temporary abandonment of certain classes of work which have, heretofore, been regularly conducted, namely, the investigation of oils, and other routine work in connexion with fuels—but notwithstanding the serious handicap under which this division laboured, a large amount of routine work was performed in addition to certain valuable research work. The investigation of lignite begun some years ago and on which the Lignite Utilization Board based the practical work in connexion with the establishment of a briquetting plant near Bienfait was practically completed and the report covering this work will be prepared by Mr. Stansfield at the earliest opportunity.

A large amount of work has already been performed in connexion with the utilization of Canadian oil-shales as a source of oil.

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## INVESTIGATIONS AND EXAMINATIONS MADE BY THE CHIEF OF THE DIVISION

Mr. Haanel in addition to his regular duties of laying out and directing the work of the division has from time to time visited laboratories in the United States where investigations concerning the distillation of coal and oil-shales are proceeding, and has secured information, blue prints, and other data pertaining to the various processes advanced and which give promise of ultimate success. He also witnessed a test conducted at the carbonizing plant of the Pennsylvania Coal and Coke Company at Cresson, Pennsylvania, in which twenty-seven tons of Nova Scotia oil-shales were carbonized in a retort of somewhat novel design; and accepted an invitation from the Trent Process Corporation, Washington, D.C., U.S.A., to inspect their experimental plant for purifying coals high in ash. The officers of this corporation were very courteous and furnished blue prints and other information concerning the apparatus employed in carrying out their process. They also conducted complete tests on several samples of coal comparatively high in ash which had been supplied at the request of the department from British Columbia, Alberta, Nova Scotia, and Saskatchewan (one sample of lignite). The results of these tests will be published in a separate report.

## MANUFACTURE OF PEAT FUEL

In addition to the above duties B. F. Haanel has conducted all the secretarial work of the Peat Committee of which he is a member. This has taken a very large part of his time.

## REPORTS READY FOR PUBLICATION

A report written by John Blizzard on powdered coal is being prepared in this division for publication at an early date, as is also a report of the investigation of commercial samples of lignite and other fuels from western Canada, with a view to ascertaining their value for the production of a power and industrial gas.

## CHEMICAL LABORATORIES

Edgar Stansfield reports in respect to the work of the chemical laboratories of the Division of Fuels and Fuel Testing that the adverse conditions for the work of the laboratory, referred to in the 1919 report, were accentuated during 1920. Mr. Stansfield's time continued to be occupied mainly by his duties with the Lignite Utilization Board, R. C. Cantelo left at the end of February to take a position with a commercial firm, and, as no new appointments were made, there were three vacancies on the staff throughout the year and four from March on. J. W. McKinney was temporarily employed for three months during the summer. Changes in laboratory arrangements necessitated transferring the work on mine air to the Sussex Street laboratory and, in June, J. Moran, mine air analyst, was transferred to the Chemical Division.

J. H. H. Nicolls was in charge of work on coal and other solid fuels, and, during the absence of Mr. Stansfield, took general charge of the laboratories. R. C. Cantelo and J. Moran, until they left, were in charge of oil and mine air analyses respectively. A. A. Swinnerton was in charge of work on oil-shale, in which he was assisted by J. W. McKinney for three months.

No increase was made in laboratory accommodation during the year, although several changes were made to increase efficiency.

Comparatively few samples were accepted for analysis during the year, on account of the lack of chemists. Thus after February no oil samples were accepted, and only a limited number of other samples.

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Further progress was made with the laboratory scale investigation on carbonization, by J. H. H. Nicolls, R. A. Strong, and others. The scope of this research has been widened to include similar work on peat. Progress was made during the year with work on oil-shale.

## MACHINE SHOPS

The equipment has been very largely augmented by lathes, milling machines, drills, etc., obtained through the Soldiers' Civil Re-establishment Department.

## CERAMIC DIVISION

Joseph Keele, Chief of Division, reports that the field and laboratory work of the Ceramic Division for the past season consisted of the investigation of raw materials used in the ceramic industries.

A large number of samples of clays and shales were tested for people in various parts of the Dominion, but as most of these samples are not very intelligently collected and the localities from which they came were not very clearly indicated the results of the tests are not recorded.

In view of the fact that most people do not know how to examine and sample a deposit of clay or shale, one of the sections of Mr. Keele's report on investigations during 1920 is devoted to instruction on these points.

The proper sampling of any deposits, especially those liable to variation at depth or those containing impurities, is most important.

Certain clays which might be utilized for the manufacture of pottery were tested in the laboratory. The results will appear in the report above mentioned.

The field work done in 1920 consisted of a continuation of the survey of available structural materials along the St. Lawrence, most of the time being spent in Soulanges, Vaudreuil, and Beauharnois counties, Quebec, and in Glengarry county, Ontario. L. H. Cole was also engaged in this work and a joint report on the resources of the region has been completed.

A short journey was made in August by Mr. Keele to the Missinaibi river in northern Ontario to examine certain deposits of high-grade sands and clays.

Owing to the difficulty of obtaining qualified assistants, the work accomplished by the Ceramic Division both in the field and laboratory was necessarily limited.

## ROAD MATERIALS DIVISION

The activities of the Road Materials Division have been curtailed to a certain extent during the present year on account of the resignation of K. A. Clark as Chief of the Division. However, investigations on road materials were carried on in Ontario and in Nova Scotia by the two remaining engineers, Henri Gauthier and R. H. Picher, who worked together.

The first part of the summer was spent between Gananoque and Napanee in Ontario, with headquarters at Kingston. During the balance of the field season investigations were started in Nova Scotia, along the Halifax-Windsor, Halifax-Truro-New Glasgow routes, and in the Annapolis valley.

Since 1914 investigational work on road materials has been undertaken in every province of the Dominion except the Maritime Provinces. In Ontario and Quebec this work has taken the form of material surveys along some of the routes of proposed main provincial highways. All available supplies of materials were then examined, mapped, and such sampling done for subsequent laboratory study as was necessary

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to determine the quality of the material and to enable discrimination to be made between good and poor deposits. In the western provinces road material investigations have been more in the direction of trying to determine how the best use can be made of such materials as exist in order to get serviceable results in road building.

Through these surveys the staff of the division was afforded opportunity to become familiar with the local conditions and problems connected with road building in the various provinces. A great deal of information on the relative road-making qualities of a wide variety of materials has been gathered which will be valuable to the highway engineers and contractors of the country.

A final report on the available supply of road material along the Gananoque-Napanee section of the Ontario provincial highway is under preparation.

In compliance with a special request from the Highway Board of Nova Scotia it was found advisable to extend the field work to that province. The work started last summer consisted mainly in the study of the local conditions and in obtaining the information needed by the highway engineers. The routes along which the inspections were made are the Halifax-Truro-New Glasgow highway, the Halifax-Yarmouth highways, via Windsor, the Annapolis valley, and Digby, and via the south shore. Some time was also spent in locating suitable material within hauling distance of the highway between Windsor and Hantsport, and over an area northwest of Kentville, where no suitable material has yet been found.

## CHEMISTRY DIVISION

The work of the Division of Chemistry has been carried on as usual under the direction of F. G. Wait, Chief of the Division.

Besides a large number of assays and analyses of ores, minerals, waters, and other miscellaneous mineral products, special investigations were commenced on two items of research—the oxidation of natural gas, and a study of the colloidal properties of bentonite.

The object of the first is to endeavour to evolve a method for the production from natural gas, in which Canada abounds, of methanol (methyl alcohol), formaldehyde, and formic acid, all of which are in ever increasing demand in the manufacturing industries, especially in England, at the present time.

The object of the second investigation will be to ascertain whether bentonite can be successfully used, as is anticipated it may be, in the manufacture of insulation materials, as fillers for textiles, soaps, and leathers, as well as in oil and colour preparations in sugar refining, and in wall-paper printing.

A plan for the study of this material has been mapped out, which it is expected will lead to satisfactory results.

One of the most important properties of bentonite is that of coagulating on the addition of alkali, and other electrolytes. In the course of the investigation, a series of experiments will be carried out to ascertain its behaviour in this regard.

Both these problems, the utilization of bentonite, and the production of methanol from natural gas, have been under consideration by the British Department of Scientific and Industrial Research, and the possibility of Canada completing their solution is hoped for.

The large deposits of bentonite in the western provinces, and our unutilized natural gas resources, will afford unlimited supplies of raw materials, if successful methods of production and treatment can be found. It is desirable that the work should be accomplished without delay, if it is to be of most value.

## SESSIONAL PAPER No 26

## DOMINION OF CANADA ASSAY OFFICE, VANCOUVER, B.C.

George Middleton, manager of the office, reports as follows:

As a result of the decreased or curtailed production of gold in British Columbia and the Yukon, there has been a falling off annually since 1918 in the gold deposited at this office. During 1918 there were 1,358 deposits of a total value of \$4,099,595.80; in 1919 the number of deposits was 1,391 and the value \$3,547,524.93, and in 1920 there have been 1,346 deposits, amounting in value to \$2,499,174.41.

There were 1,346 deposits of gold bullion melted, assayed, and purchased; the smaller deposits were melted into large bars which were assayed prior to shipment to the Royal Mint at Ottawa; a total of 1,404 meltings and 1,404 assays were required in connexion with the purchase and disposal of the bullion, all assays being run in quadruplicate.

Ten thousand cupels of various sizes were made and 242 pounds of slag treated and the values contained in same recovered.

The aggregate weight of the gold bullion deposits before melting was 150,869.37 troy ounces and after melting 147,718.37 troy ounces, showing a loss in melting of 2.0886 per cent. The loss in weight by assaying was 23.69 troy ounces, making the weight of bullion after melting and assaying 147,694.68 troy ounces, the average fineness of same being 0.814 gold and 0.138½ silver.

The net value of the gold and silver contained in deposits was \$2,499,174.41, the sources of production being as follows:

Source	Number of deposits	Weight		Net value
		Before melting and assaying	After melting and assaying	
		(troy ozs.)	(troy ozs.)	
British Columbia	892	76,413.36	73,882.30	\$1,292,595.66
Yukon.....	454	74,456.01	73,812.38	1,206,578.75
	1,346	150,869.37	147,694.68	\$2,499,174.41

## DRAUGHTING DIVISION

H. E. Baine, Chief Draughtsman, reports that the following maps, diagrams, charts, etc., were published or completed during the calendar year ending December 31, 1920:

*Published*

No. 532. Map showing deposits of stone and gravel available for highway construction between Cardinal, Ontario, and the Quebec boundary, accompanying report No. 530: "Road materials, Montreal-Toronto highways." October 11, 1920 (out of print); scale 2 miles to 1 inch.

*Completed*

Map of portion of McMurray district, Alberta, showing provisional classification of principal outcrops of bituminous sand, 4 sheets; scale 40 chains to 1 inch (not for publication).

Map showing position of test pits on portion of Horse River reserve, McMurray, Alberta (not for publication); scale 200 feet to 1 inch.

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No. 559. Map showing distribution of sandstone in the vicinity of Ottawa, Ont.; scale 4 miles to 1 inch.

No. 560. Map showing distribution of sandstone in the vicinity of Montreal, Que.; scale 4 miles to 1 inch.

No. 558. Map showing distribution of sandstone in the district north of St. Lawrence river, between Kingston and Brockville; scale 4 miles to 1 inch.

No. 562. Map showing distribution of quartzite in the Kamouraska district, Que.; scale 4 miles to 1 inch.

No. 557. Map showing distribution of sandstone in the district north of Nelles Corners, Haldimand county, Ont.; scale 4 miles to 1 inch.

No. 563. Sketch map of Pilgrim islands, river St. Lawrence, near St. André, Kamouraska county, Que.; scale 1,000 feet to 1 inch.

No. 561. Sketch map of quartzite deposits in the townships of Chavigny and Montauban, Que.; scale ½ mile to 1 inch.

- 145 mechanical drawings, diagrams, charts, and flow sheets, etc.
- 110 black and white prints.
- 250 blue prints.

LIBRARY

Mrs. O. P. R. Ogilvy, librarian, reports that the end of the year 1920 shows a marked growth in the Mines Branch library.

Through the generosity of Eugene Haanel, the retiring director, the library has been enriched by the addition of many scientific books from his valuable private collection.

Important foreign files—broken by the vicissitudes of war—have, during the year, been brought up to date.

ACCESSIONS, 1920

By purchase.. . . .	153
Books (by gift).. . . .	190
Books (bound).. . . .	188
Canadian government documents.. . . .	821
Foreign government documents.. . . .	1,662
Scientific societies, transactions.. . . .	584
Pamphlets.. . . .	69
Trades catalogues.. . . .	95
Maps.. . . .	143
Total accessions.. . . .	3,257

SESSIONAL PAPER No 26

## EXPLOSIVES DIVISION

*Lt.-Col. G. Ogilvie, Chief Inspector of Explosives*

This financial year is coincident with the first year of operation of the Explosives Act, which has been administered by the Explosives Division of the department.

The bringing into force of the Act and regulations, affecting as they do parties of various industries and trades, to the large majority of whom they appeared as an entirely new departure—as indeed they were in this country—is in itself a task which has demanded very careful handling. To a considerable degree also, the activities of the division have, of necessity, had to be directed along educative channels. This is readily understood when it is remembered that the absence of any previous legislation governing the conditions of manufacture and storage of explosives has allowed, in many cases, of the development of practices in the handling of these which are fraught with danger not only to the owners or users, but also to the public.

The seventeen factories in operation at the close of the financial year have all been inspected, and licences or continuing certificates issued or prepared for them. The preparation of these involves a study of, and the giving of rulings regarding the erection and layout of plants and the actual processes which may be conducted therein. The quantity of explosives and number of persons permitted to be in each building are determined, and the discipline which will be observed throughout the factory regulated.

In like manner forty permanent magazines and thirty-three temporary magazines have been dealt with. Others are subject of inquiry at present and it is to be expected that still more have yet to be located.

In this matter, and also in that of bringing to the notice of small dealers the requirements of the Act in relation to the keeping of explosives in unlicensed premises, the services of the Royal Canadian Mounted Police have been invaluable. Without their co-operation it would have been impossible to reach, in any reasonable period, the widely scattered users of, and dealers in, explosives. To the prestige of that force and the good judgment exercised by its members must be credited much of the improvement now being effected in the conditions of storage.

Advantage has been taken of such opportunities as have been found, of getting into direct touch with municipal police and fire brigade officers to further an understanding of the aims of the Act, particularly in reference to the regulations governing storage of explosives in unlicensed premises and to their conveyance.

The procedure followed in regard to the importation of explosives is proving satisfactory. As may be seen from the returns published with the report of the division for the calendar year 1920, the quantity of explosives other than required for use in manufacture, and except also fireworks, was very small. Fireworks are, however, largely imported, and the manufacturers of these have been called upon to supply particulars as to the nature and composition of their goods for authorization. It has been found advisable to exclude certain 'Salutes' and compositions containing potassium chlorate and white phosphorus, also, in default of the information required being supplied, to stop the importation of Chinese fireworks with the exception of certain of the smaller types.

Information has been obtained from various sources regarding accidents which have occurred with explosives during the calendar years 1919 and 1920 and this has been condensed and classified according to the causes, and is given in the annual report of the division. In all, records were obtained of sixty-two accidents

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in 1919, resulting in the death of twenty-seven persons and injury to forty-one. In 1920, during which year inquiries were extended, eighty-three were traced and these were responsible for the death of thirty-one persons and for injury to seventy-three. Since the coming into effect of the Act, four accidents have formed the subject of special investigation and report.

In the course of the year under review regulations have been issued (Orders in Council Nos. 2601 and 2602) dealing specially with the keeping of fireworks both in large quantities requiring for their storage licenced magazines, and in quantities such as may properly be kept in unlicenced premises. These are less stringent than the corresponding regulations dealing with explosives in general.

The testing of explosives has been proceeded with as rapidly as the facilities will permit of, precedence being given to any new explosives, with which there is no delay, but in this work we are handicapped by the fact that since the first of January the chief explosives chemist has been without an assistant.

Plans have been prepared for the establishment of a testing station where the suitability or otherwise of explosives for use in coal mines may be determined in order that, should provision be made for this service, the necessary equipment may be installed with as little delay as possible.

The staff of inspectors consists only of the chief inspector and one inspector. In the interest of economy the appointment of another inspector was deferred, but the need of such addition being now greatly felt, it is hoped that the staff may be strengthened in the near future.

## EDITORIAL DIVISION

*William McInnes, Editor-in-chief*

The Department issues from time to time, as they can be prepared, reports, memoirs, and bulletins from its various divisions. Memoirs and Bulletins of the Geological Survey and Victoria Memorial Museum are issued under the supervision of F. Nicolas, Editor, and reports of the Mines Branch, under the supervision of Samuel Groves, Editor. In addition to the reports issued in English, many are issued in French, under the supervision of Jobson Paradis, Head Translator. The following lists include the reports published by the department during the calendar year 1920; and the French publications distributed during the year.

## GEOLOGICAL SURVEY

*English Publications*

1723. *Annotated catalogue of and guide to the publications of the Geological Survey, 1845-1917*, by W. F. Ferrier; pp. 1-544; maps, 10; edition, 5,000 copies; published, May 26, 1920.
1773. Memoir 117. Geological Series 99, *Geology and ore deposits of Ainsworth mining camp, B.C.*—by S. J. Schofield; pp. i-iv, 1-73; plates, 3; figures, 6; maps, 12; edition, 2,500 copies; published, May 25, 1920.
1783. Memoir 115. Geological Series 97, *Geology of Matachewan district, northern Ontario*—by H. C. Cooke; pp. i-ii, 1-60; figures, 5; map, 1; edition, 2,500 copies; published May 26, 1920.
1804. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1919, Part G*; pp. 1G-23G; figures, 2; edition, 3,000 copies; published, May 3, 1920.
1805. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1919, Part B*; pp. 1B-53B; figures, 2; edition, 3,000 copies; published, July 16, 1920.
1806. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1919, Part D*; pp. 1D-21D; figures, 2; edition, 3,000 copies; published, June 25, 1920.
1813. *Summary Report of the Geological Survey, Department of Mines, for the calendar year 1919, Part C*; pp. 1C-28C; figures, 3; map, 1; edition, 3,000 copies; published, August 11, 1920.
1828. Memoir 121. Geological Series 103, *The Malagash salt deposit, Cumberland county, N.S.*—by A. O. Hayes; pp. i, 1-24; figure, 1; maps, 2; edition, 2,500 copies; published, December 23, 1920.
- Report of the Canadian Arctic Expedition, 1913-1918—volume III: Insects—Separates—Introduction and list of new genera and species collected by the expedition*, by C. Gordon Hewitt; pp. 1-11; edition, 3,000 copies; published, December 10, 1920.
- Part I. *Lepidoptera*—by Arthur Gibson; pp. 1I-58I; plates, 6; edition, 2,000 copies; published, January 10, 1920.
- Part J. *Freshwater copedia*—by C. Dwight Marsh; pp. 1J-25J; plates, 5; edition, 2,000 copies; published, April 21, 1920.
- List of publications of the Geological Survey*; pp. 1-10; edition, 1,000 copies; published, December 3, 1920.
- Report on field study of life histories of Canadian mammals*, by R. M. Anderson. Reprint from the Canadian Field Naturalist, Ottawa; edition, 250 copies; published, February 3, 1920.

*French Translations*

1770. Mémoire 114, No. 95, Série géologique, *Matériaux de voirie dans la ville et le district de Montréal, Québec*, par Henri Gauthier; pp. i, 1-56; plates, 4; figure, 1; map, 1; edition, 1,000 copies; published, March 6, 1920.
1772. *Rapport sommaire de la Commission géologique, du Ministère des Mines, pour l'année civile 1918, Partie A*; pp. 1A-20A; edition, 1,000 copies; published, February 25, 1920.
1810. Mémoire 113, No. 96, Série géologique, *Géologie et gisements-minéraux d'une partie du canton d'Amherst, Québec*, par M. E. Wilson; pp. i-iii, 1-56; plates, 7; figures, 3; maps, 2; edition, 1,000 copies; published, November 11, 1920.

## MINES BRANCH

*English Publications*

496. *Results of forty-one steaming tests conducted at the Fuel Testing Station, Ottawa. Bulletin No. 27*—by John Blizard, B.Sc., and E. S. Malloch, B.Sc.; pp. 1-83; figures, 11; charts, 41; edition, 2,000 copies; published, February 25, 1920.
509. *Summary Report of the Mines Branch, Department of Mines, for the calendar year 1918*; pp. 1-225; figures, 6; diagrams, 9; edition, 3,000 copies; published, January 22, 1920.

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511. *Graphite, Report on*—by H. S. Spence, M.E.; pp. i-ix, 1-202; plates, 56; figures, 43; maps, 6; edition, 4,000 copies; published, July 6, 1920.
520. *The mineral production of Canada, for the calendar year 1918*. Annual report on—by John McLeish, B.A.; pp. 1-80; edition, 4,000 copies; published, January 7, 1920.
522. *Report on some sources of helium in the British Empire*. Bulletin No. 31—by J. C. McLellan, Ph.D., F.R.S., and associates; pp. i-viii, 1-72; plate, 1; figures, 20; maps, 4; edition, 3,000 copies; published, June 4, 1920.
529. *Production of iron and steel in Canada, for the calendar year 1918*. Report on—by John McLeish, B.A.; pp. 1-36; edition, 3,000 copies; published, March 8, 1920.
530. *Road materials along the St. Lawrence river from the Quebec boundary to Cardinal, Ontario*. Bulletin No. 32—by R. H. Picher; pp. i-ii, 1-65; plates, 6; map, 1; edition, 3,000 copies; published, October 15, 1920.
533. *The mineral production of Canada for the calendar year, 1919*. Preliminary report on—by John McLeish, B.A.; pp. 1-24; edition, 6,000 copies; published, March 6, 1920.
544. *Production of iron and steel in Canada, for the calendar year 1919*. Report on—by John McLeish, B.A.; pp. 1-45; edition, 3,000 copies; published, December 16, 1920.
- The mineral resources and mining industry*. Pamphlet for distribution at the Sixth National Exposition of Chemical Industries, New York; edition, 1,500 copies; published September 21, 1920.

*List of Mine Operators—*

- List of metal mines in Canada; published, July 10, 1920.
- List of petroleum and natural gas wells; published, November 22, 1920.
- List of lime kilns in Canada; published, November 9, 1920.
- List of cement mills and sand lime brick plants; published, November 9, 1920.
- List of manufacturers of clay products; published, November 16, 1920.
- List of coal mines in Canada; published, November 26, 1920.
- List of stone quarry operators in Canada; published, November 19, 1920.
- List of sand and gravel operators in Canada; published, November 19, 1920.
- Statistical form 19A: Gold, copper, and nickel; published in December, 1920.
- Statistical form 19A: Gold, copper, and nickel; published in December, 1920.

*French Translations*

510. *Rapport sommaire de la Division des Mines, du Ministère des Mines, pour l'année civile 1918*; pp. 1-235; figures, 6; diagrams, 9; edition, 1,000 copies; published, July 22, 1920.
521. *La production minérale du Canada pour l'année civile 1918*. Rapport annuel—par John McLeish, B.A.; pp. 1-80; edition, 1,000 copies; published, July 3, 1920.

EXPLOSIVES DIVISION

*English Publication*

- 1 *Annual Report of the Explosives Division, Department of Mines, for the calendar year 1919*; pp. 1-45; edition, 3,000 copies; published, April 5, 1920.

*French Publication*

- 2 *Rapport annuel de la Division des Explosifs du Ministère des Mines, pour l'année civile 1919*; pp. 1-52; edition, 1,000 copies; published, July 12, 1920.

FRENCH PUBLICATIONS DISTRIBUTED DURING THE CALENDAR YEAR 1920

*Geological Survey*

During the year 1920, 16,969 copies were distributed. Of these, 3,617 were distributed in compliance with written and personal requests, and 13,352 were sent to addresses on the mailing lists.

*Mines Branch*

During the year 1920, 4,010 copies were distributed. Of these, 1,459 were distributed in compliance with written and personal requests, and 2,551 were sent to addresses on the mailing lists.

*Explosives Division*

During the year 1920, 794 copies were distributed. Of these, 156 were distributed in compliance with written and personal requests, and 638 were sent to addresses on the mailing lists.

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## ACCOUNTING DIVISION

## ACCOUNTANT'S STATEMENT

*P. R. Marshall*

The funds available for the work and expenditure of the Department of Mines for the fiscal year ending March 31, 1921, were:

	Grant	EXPENDITURE	
		Amount	Total
	\$ c.	\$ c.	\$ c.
DEPARTMENT—			
Amounts voted by Parliament.....	237,601 67		
Civil list salaries.....		45,397 50	
Lignite Utilization Board.....		140,000 00	
Grant to Imperial Mineral Resources Bureau.....		12,166 67	
Expenses of the Explosives Division.....		11,314 40	
Civil government contingencies.....		3,769 66	
			212,648 23
Balance unexpended and lapsed.....			24,953 41
MINES BRANCH—			
Amounts voted by Parliament.....	429,660 41		
Civil list salaries.....		102,607 56	
Investigation of peat fuel industry.....		32,415 17	
Expenses of fuel testing plant and laboratory.....		30,386 97	
Expenses of ore dressing and metallurgical plant.....		24,116 54	
Cost of living bonus.....		21,682 52	
Investigations of ore deposits and economic minerals.....		18,387 29	
Wages of temporary employees.....		14,733 37	
Publication of reports and maps.....		9,683 26	
Chemical laboratories.....		9,670 07	
Sundry printing and stationery.....		4,436 19	
Miscellaneous.....		3,246 67	
Expenditure chargeable to Superannuation Fund No. 4, Retirement Act.....		966 66	
			272,332 27
Balance unexpended and lapsed.....			157,328 14
DOMINION OF CANADA ASSAY OFFICE—			
Amount voted by Parliament.....	29,282 30		
Earnings.....	12,202 64		
Salaries of staff.....		19,448 02	
Cost of living bonus.....		2,897 30	
Fuel, power, and light.....		1,043 72	
Assayers' supplies.....		1,081 76	
Contingencies.....		768 51	
Premium on bonds.....		600 00	
Electric burglar alarm service.....		360 00	
			26,199 31
Balance unexpended and lapsed ..			15,285 63
GEOLOGICAL SURVEY—			
Amount voted by Parliament.....	672,589 50		
Civil list salaries.....		228,507 19	
Explorations, surveys, and investigations.....		181,540 92	
Publications of reports and maps.....		41,832 54	
Cost of living bonus.....		38,348 68	
Wages of temporary employees.....		27,070 11	
Sundry printing and stationery.....		18,563 03	
National Chemical Exposition.....		6,026 66	
Miscellaneous.....		4,923 08	
Biological Division.....		4,464 83	
Laboratory supplies.....		3,751 54	
Specimens for Museum.....		3,287 69	
Photographic supplies.....		2,841 89	
Miscellaneous gratuities.....		1,810 00	
Instruments and repairs.....		1,785 02	
			564,753 09
Balance unexpended and lapsed.....			107,836 41
	1,381,336 52		1,381,336 52

Summary

	Grant		Expenditure		Grant not used	
	\$	c.	\$	c.	\$	c.
Civil government salaries . . . . .	446,682	50	341,821	63	104,860	87
Department . . . . .	180,166	67	167,250	73	12,915	94
Mines Branch . . . . .	272,100	00	145,735	85	126,364	15
Assay Office, \$26,000.00 plus earnings \$12,202.64.....	38,202	64	22,917	01	15,285	63
Geological Survey.....	339,500	00	293,522	97	45,977	03
Cost of living bonus.....	62,928	50	62,928	50		
Increases due to re-classification.....	38,979	55	38,979	55		
Miscellaneous gratuities . . . . .	1,810	00	1,810	00		
Expenditure chargeable to Superannuation Fund No. 4, Retirement Act.....	966	66	966	66		
	1,381,336	52	1,075,932	90	305,403	62

Casual Revenue

Sales of publications . . . . .	\$ 1,449 48
Sales of explosives permits and licences . . . . .	389 35
Sales of equipment . . . . .	388 00
	\$ 2,226 83

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